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THE

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PROFESSIONAL ETIQUETTE AND COMMERCIAL MORALITY.

WE have reluctantly to refer again to conduct on the part of some ostensible members of our profession, which is not creditable to themselves, is injurious to others, and, by reflection, tends to lower the moral and social status of all who are connected with electrical engineering. The conduct in question is not only unprofessional; but, to descend to a lower level, it is also untradesmanlike. Partly as cause, and partly as effect, it is connected with a great deterioration in the general tone of the corporate representatives, in this country and in the United States, of what should rank as one of the learned professions, as well as the most important of growing industries. Were it not so, we should not stand alone with a protest which, however urgently called for, does not properly devolve exclusively, or even mainly, upon ourselves.

In presence of the facts, it is scarcely necessary, on our part, to deprecate the imputation of undue squeamishness, or of a desire to pose as the representative of all the virtues. We confess to a reverence, at least, for the *ideal* professional man of times past, whose honour, guarded by a punctilious etiquette, was as bright as any gentleman's sword. We admit that we have a respect for the old-fashioned tradesman who, as Sir Walter Besant says, "lived over his shop, and wasn't a bit ashamed of it." But *autre temps, autre mœurs!* The old order passeth away, and giveth place unto the new. To be *laudatores temporis acti*, and *stare super vias antiquas*, may be very well; but, for practical purposes, to move with the times is better. We quite admit that in the ball-room we require good dancers even more than we do professors of ethics, and that in commerce we require men who can hold their own in the strife of competition. Even did we not require them, we should get them; for the others—like those whose dancing days are over or have not yet commenced—have to go to the wall. Rose-water, we are aware, does not largely enter into the *matériel* of warfare; and in trade, we are ready to allow, we cannot always love our neighbour *quite* as ourselves—our work must be selfish, though it need not therefore be ignoble.

But the line must be drawn somewhere, and for those who claim the title of professional man, it must be drawn higher up and more sharply than for those who make no pretention to be other than tradesmen. It has long been an axiom that the professional man cannot—must not—condescend to advertise himself; this axiom is of effect in the professions of medicine and law; we think it should continue to apply to our own. *Noblesse oblige;* and those who can see no incongruity in the adoption by members of a learned profession of the ordinary means of trade advertisement, can escape from an alleged hardship by what in their case would

be an inappreciable derogation. More objectionable than the ordinary and more or less venial forms of exaggeration and false pretence which are almost inseparable from the modern *annonce*, is the practice on the part of *soi-disant* professional men of seeking custom. As some of our readers are well aware, there are consulting electrical engineers who do this. Their object is usually to oust a professional brother, and to push themselves into his place. Unlike George Stephenson, their *forte* is the "engineering of man," and more especially of municipal authorities. It is conduct such as this that we reprehend. When it becomes prevalent and notorious, a *laisser-faire* policy on the part of a corporate body representing the profession—or on the part of a journal occupying the same position in a less degree—would be simply disgraceful, and would justify the expression by a member of the legal profession, in a recent case at Bow Street, that "the prisoner was not a gentleman: he was an electrical engineer."

What would be the effect of the same conduct in another profession? Let us see. Sir Samuel Pactolus, we will suppose, has called in Dr. Dexter, and requested him thoroughly to examine the lungs of his son and heir, and to report at length as to the best means to be adopted with a view to strengthen and improve them. To the baronet, next day, comes Dr. Sinister, professing the utmost interest in the young gentleman's health, expressing grave doubts as to the ability of Dr. Dexter to deal with the case, and finally winding up with an offer to do the auscultation, and to draw up the report, at a reduction of 20 per cent. on the aggregate amount of that gentleman's fees.

Would this be possible in the medical profession? And, if so, what would be the action of the General Medical Council when the case was brought before them?

In the gross *manque de convenance* we have indicated, there are degrees of impropriety and "caddishness." To the consulting engineer who boldly and openly touts for himself we cannot say much more than this: that he belongs to a lower grade than that with which he is ostensibly associated; although we think that the Institution of Electrical Engineers might say to him something more. But the man who, directly or indirectly, employs the professional tout, becomes chargeable with the misdeeds of the latter.

Between the professional tout and the straightforward commercial traveller, who pushes the sales of the manufacturer and tradesman, we, of course, draw a very wide distinction. There is usually nothing about the business of the latter that he need hesitate to avow. But the former would not care to show his hand; his success and prosperity are due to vulgar impudence of the most objectionable kind. A survival of the fittest—which, as Darwin explains, is by no means always the best—he *is* successful and prosperous, not only as compared with the men to whose detriment he works, but as compared with manufacturers, who are almost forced to employ him.

We understand that three varieties of this interesting species, which has recently developed into some importance, are known in America, although the distinctions between them can be recognised only by the expert who has overcome the natural repugnance to study closely the habits and characteristics of these creatures. They are known as "sand-baggers," "double-enders," and "commission men." Their first object is to ferret themselves into some position of technical trust. Their next step, in the words of a New York expert, is "to prostitute themselves and their profession, for a sum of money, or its equivalent, to a manufacturer whose goods they recommend to, and often purchase for, their employers, irrespective of the merits of the goods."

The most dangerous and objectionable variety of the species, however, is what has been termed the tripartite combination tout. Having all the essential characteristics of the tout species, it is at the same time, or alternately at different periods, journalist, trade representative, and consulting engineer's advocate. In the former capacity it collects valuable information with great facility; in the second it draws support freely from several sources, and is thus independent of journalistic exertion, and in its last capacity is always in touch with municipalities likely to want reports.

In conclusion, and very seriously: there are, of course, consulting electrical engineers whose names are above any imputation; nor, indeed, would we have it understood that our strictures apply to more than a small minority. But in certain electrical circles, too numerous to be of insignificance, the absence of high principle, the want of appreciation of that which constitutes honourable dealing between man and man, and the disregard of the simplest code of professional etiquette, are of grave significance, and call for strong condemnation.

The British Association and the Practical Man.

The exact attitude taken by the practical man to the British Association meetings is a little difficult to define, although his opinions regarding the annual meeting have been freely expressed in technical literature during recent years. The B.A. meetings fulfil one of the principal objects for which the Association was established, and fulfil it well, inasmuch as a convenient gathering brings together workers in different branches of scientific thought and its applications to the arts, thus insensibly causing the practical man to moderate his contempt for the mere theorist, whose theory he frequently finds can be made of use in his own work, and it tends towards a more cordial feeling on the part of the more purely scientific worker for his fellow who desires to obtain "results" as a fitting conclusion to his labours. The absence of the engineer from B.A. gatherings is rather to be regretted, and has been marked during the past few years. Many of the triumphs of engineering skill are as far removed from the comprehension of the lay mind as any of the masterpieces of theoretical conception, and accurate, intelligible, descriptions by engineers of their creations are as of great value to an average B.A. audience as most of the classical papers submitted in the science sections. There was a time when a good many well-known men attended the Mechanical Science Section year by year, but they seem to have given up the visit within the last five or six years, and yet this department has, if anything, better fulfilled the ideas conveyed by its title than was formerly the case. This year we have some useful papers promised in mechanical science, and their value must depend largely upon the discussions they elicit. To make a discussion of general interest and far reaching in its tenour, the speakers must be representative members of the profession, and we only hope that it will be the rule rather than the exception for a carefully prepared paper to receive adequate discussion. We believe that the B.A. offers facilities for informal interchange of ideas amongst the engineering fraternity that are lacking in the majority of the more severely "regulated" societies and institutions.

ON SOME MODERN VOLTAIC CELLS OF HIGH ELECTROMOTIVE FORCE.

By DESMOND G. FITZGERALD.

The voltaic couple has been, and will probably continue to be, the main entrance to the domain of electro-chemistry; and a fascinating opening it is to those whose tastes lie in that direction. Although we are not in urgent need, practically, of new voltaic combinations—more especially if they are to be worked by a limited company, and to furnish bye-products of enormous commercial value—there is ample scope for profitable labour in the introduction of improved appliances for the laboratory. Here, where future innovations are incubated, the student cannot repeatedly substitute one electro-positive for another of less intrinsic energy—obtaining the energy difference as watt-hours—without obtaining much knowledge of the practical kind that is most needed by students in the present day. *Operæ pretium est;* the time thus agreeably spent is by no means wasted. But let the nature-compellers *in embryo*, work with their hands as well as with their heads, collect their own residues, clean and put by their own apparatus, and clear up their own "messes."

I have always considered it most unfortunate that in the laboratory so little should usually be known of the requirements of outside workers, and that amongst outside workers so little should be known of what has been, and what is being done, in the laboratory. Although much has been done, notably by the Society of Arts, to bring into communication the laboratory men and the practical workers, they have not succeeded, generally, in establishing relations to their mutual advantage. If, as Izaac Walton says, a man may lose what he has never had, I am convinced that both are heavy losers through this isolation. In Chili a man might possibly have "nitrate," tallow, and granular copper in superabundance, and yet be suffering from a dearth of soap and oxidants. In the laboratory his kinsman may, year after year, obtain his supplies of pure caustic alkali by heating together grains of copper and "nitrate," and utilise the bye-product of this operation as an oxidant, without having any inkling of the fact that, under given conditions, the application of the process on a large scale might realise a fortune. My assistant there is evolving chlorine from an anode of lead-peroxide, quite unattackable by that nearest approach to the Alkahest. Another man may be wasting golden opportunities because he cannot find a permanent anode. In the laboratory we have latterly been using 3-volt cells, with zinc as the positive element, for charging small accumulators; and the question as to their economy seems likely to be decided in the affirmative. Outside of the laboratory, a practical man confidently asserts his conviction that no practical battery has ever been invented with an electromotive force higher than that of the Grove cell. And no doubt he is aware that an E.M.F. of 1·97 is about the highest that can be claimed for the latter.

These misconceptions, this ignorance of what is known, has been—perhaps is still—a commercial disadvantage and a financial danger. It is apt also to make a whole community ridiculous. A young genius, leaving the beaten track, makes a great discovery. It is a voltaic couple of zinc and of platinum in contact with peroxide of lead. Only it is far superior to any battery hitherto constructed. The *savant*, accompanied by a few friends, whom the veterans of the first Napoleon's *armée d'Egypte* would have termed demi-savans, gets his invention favourably noticed by a dozen non-technical papers, circulating amongst some of the shrewdest people in the world. He then, we will suppose, puts forward the following statement:—

"I have even succeeded in obtaining by this combination a pair capable of actively decomposing water, acidulated by sulphuric acid, in a voltameter with platinum wires. The peroxide, brought to the state of a dry and fine powder, is carefully rammed into a porous trough of unglazed porcelain, such as those which are used in Grove's battery. A thin plate of platinum is placed in the middle of the trough, so that it is completely enveloped by peroxide. This plate carries an appendage to which is soldered a conducting wire. The porous vessel filled with peroxide, and also a plate of amalgamated zinc, are plunged into a saline or acid solution. The plates of zinc and platinum are then respectively connected to the two electrodes of a voltameter. By this means as much as $\frac{3}{5}$ths of a cubic inch of the mixed gases are obtained in a minute; whilst with a Grove couple, similar except that nitric acid is substituted for the peroxide of lead, a scarcely appreciable decomposition is produced."

Now, considering that the above statement is perfectly true, and can be conscientiously verified by the scientific expert; considering also that a plausible superstructure could be built on this solid foundation, is it very absurd to suppose that the invention might be "taken up," to the tune of some thousands of pounds sterling, by the very shrewd persons aforesaid? Of course they would not be aware that the above statement was written, more than forty years ago, by a man of the name of De la Rive! Nor would they be acquainted with the various articles on primary and secondary peroxide of lead batteries which appeared in the old *Electrician* as long ago as 1862 and 1863.

Substitute—for the sake both of economy of construction and low internal resistance—an ample conductor of lead for the platinum plate; unite the metal and the active material, *secundum artem*, in good conductive contact; obtain your peroxide electrolytically from a cheap bye-product, instead of from red lead by the action of nitric acid, and keep it moistened with sulphuric acid; immerse the zinc element preferably in a solution of oxalic acid instead of dilute sulphuric acid, and you have the modern Zn PbO_2 primo-secondary battery. It is not necessarily a primary battery, because, if you have access to a dynamo, the most economical mode of working is to renovate your porous-pot peroxide elements by recharging instead of throwing them away like an exhausted Leclanché pot. It is not a secondary battery, because, on a small scale, it is not worth while to attempt to recover the zinc dissolved, and the recovery could be effected only by a skilled electro-chemist. One reason for not throwing away the peroxide pots—however cheaply they may be supplied—is that they improve very much by recharging. Thus an element which, when new, may give only 5 or 6 ampère-hours, may ultimately, by the effect of recharging, give 12 or 14 ampère-hours.

Although the charged pots may be stored—preferably in a damp place—for long periods, the above is not to be recommended as a "waiting" battery. In this respect it cannot compare with the various forms of the Leclanché, nor indeed with the old Marié-Davy cells. But for the experimenter and student—for all the purposes to which the Grove and the Bunsen cells have been applied—I think it will be found pre-eminently suitable.

A freshly mounted couple of the size of No. 2 Leclanché gave, on testing, the following values:—

E.M.F. 2·52 volts.
Internal resistance (ρ) = ·67.
Current (through 2·56 ohms) = ·78.
In 24 hours the E.M.F. had fallen to 2·50.

A current was then taken from it during 48 hours, the initial value being about ·25, and the final value about ·22 ampère. The E.M.F. was then found to be 2·44 *v*, and the internal resistance ·94 ohm. After 12 days' occasional use, the voltage is 2·50, and the current through 2·56 ohms is ·72 ampère. These tests will give a rough idea of the character of the cell, the peroxide element of which has been recharged only once.

An important modification of this cell, in which the zinc element was immersed in a solution of caustic potash of density about 1·20, contained in a second porous pot, tested initially as follows:—

E.M.F. = 3·05 volts. ρ = 2·44.

The internal resistance, which is here very high, of course depends upon the degree of porosity of the two porous pots, whilst the capacity of the cell, and the constancy of the current depend upon the weight, the chemical, and also the *physical* character of the peroxide active material, and the supply of alkaline fluid to the zinc element. These considerations, together with the following test values, will give a general idea of the practical working of this couple. After standing by for 48 hours, it tested as follows:—

E.M.F. 2·97. ρ = 2·15.

I find this cell useful and also *economical*, in spite of the consumption of alkali, for charging pocket accumulators, one cell being amply sufficient for each secondary cell to be charged. Caustic soda may economically be substituted for the potash without appreciable detriment.

The battery of Ward & Sloan, experimented with by Prof. Dolbear, has been described in these pages.* To this the battery recently put forward by M. Morisot bears a strong family likeness. The former was constructed with zinc in a solution of caustic soda and carbon in a mixture of nitric and chromic acids with common salt in solution. One porous pot or partition was used, and the initial E.M.F. was 2·87 volts. In Morisot's battery two porous pots or partitions are employed, as in the 3-volt peroxide couple. The zinc is immersed in a solution of caustic soda of Sp.G. 1·25, the carbon in a solution of chromic acid; whilst the solution in the outer vessel is a solution of caustic soda of Sp.G. 1·05. The E.M.F. is considerably lower than that of the Ward & Sloan battery, being given as 2·5 volts, but the initial value would be somewhat higher. It would be interesting to test these two batteries for effectiveness, convenience, and cost, against the two forms of primo-secondary cell above described.

There is, according to my experience, only one kind of carbon plate (besides graphite) that is permanent when immersed in an acid electrolyte, viz., that known as retort carbon. And there is but one safe mode of establishing contact with the material, viz., by means of platinum, a disc of which may be used in conjunction with a wire of the same metal, and an ebonite screw with ebonite nuts.

Another 3-volt battery which has recently been described is, I should think, outside of the domain of the practical by reason of the employment of *magnesium* as the positive element. This metal is immersed in a solution of ammonic chloride, no means being indicated for obviating the local action which occurs under these conditions. The negative element is copper, in a solution of cupric chloride acidulated with hydrochloric acid. As to the 3 volts, they have been obtained, and may be obtained, in more ways than one; although a journal, the readers of which, and the contributors to which, are in many cases scientific, is somewhat sceptical on this point, and opines that "the electrician preserves an open mind, and waits for the 3 volts until he gets them."

In this same journal, nevertheless, an announcement embodying a very ancient fallacy is made in a form somewhat suggestive of a practical joke. It is that of a "high-tension single cell," credited to an inventor named Hugo Schroeder, and capable of performing any work taking from 20 to 30 amperes under an E.M.F. of 20 to 30 volts. What the writer terms the "internal resistance of the cell"—the latter being constituted by 20 zinc-carbon couples connected in series but immersed in the same electrolyte—is given as 1 ohm; from which statement, in conjunction with the preceding one above, we may gather that the external resistance may be either ·5 ohm, *nil*, or −·3 ohm. We are, in fact, warned that the resistance of the "outer circuit" must be kept low in proportion to the internal resistance of the cell.

Another curiosity is announced; a battery "of great internal resistance" composed of two plates of thin lead wound spirally, "but so as not to touch each other." The insulation is effected by means of paraffin wax, and the electrolyte is strong sulphuric acid. The most striking novelty here is the practical negation of the proverb anent the advertisement of the condition of incipient decomposition in fish intended for sale.

THE WORKING EXPENSES OF ELECTRIC AND CABLE RAILWAYS.†

The tables of the working expenses of electric and cable railways in Great Britain, published in the *Railway World*‡ in September and October last year, received a good deal of attention from those interested in improved methods of traction. The twelve months which have elapsed give another year's experience, and we propose here to republish the tables and bring them down to date, that is to say, to include the accounts of the companies concerned down to June 30th last. No additions can yet be made to the number of companies publishing separate accounts of the results of operating by cable and electricity, but everything points to a speedy change in this respect. For the present, however, we must rest content with the results of the working of the Liverpool and South London electric railways, the Birmingham cable and electric tramways, and the Edinburgh cable tramways. The following tables show the results of the operating of the Liverpool line since it was opened in the early part of 1893:—

Table I.—Liverpool Overhead Electric Railway.

Per Train Mile—Pence.

Half-year.	Maintenance o' way, works, and stations.	Locomotive power.	Car repairs and renewals.	Traffic expenses.	General charges, taxes, &c.	Total expenses.
June, 1893... (17 weeks)	...	4·00	...	7·05	4·36	15·41
Dec., 1893 .	1·7	4·03	...	5·32	2·48	13·53
June, 1894 .	1·69	2 88	·38	5·68	2·89	13·52
Dec , 1894 .	2·00	3·25	·18	5·09	2·58	13·1
June, 1895...	2·23	3·49	·21	5·4	3·05	14·38

Table II.—Liverpool Line—Totals.

Half-year.	Expenses per train mile.	Receipts per train mile.	Per cent. of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
				£	£		
June, 1893... (17 weeks)	15·41	27·23	56·59	6,990	12,352	108,850	1,370,742
Dec., 1893...	13·53	18·07	74·87	13,732	18,342	243,589	2,475,639
June, 1894...	13·52	18·1	74·69	14,947	20,012	265,349	2,861,437
Dec., 1894...	13·1	19·59	66·87	17,162	25,675	314,472	3,641,379
June, 1895...	14·38	21·65	65·42	18,654	28,082	311,346	3,460,060

It is needless to go again into all the explanations which were given in the articles on the same subject last year. Readers who require to have elucidation may readily refer back. It may, however, be noted that in 1893 the Liverpool locomotive power was supplied by contract at a fixed rate. There was a great drop in this charge per train mile in the first half of 1894 when the company took the running into their own hands, and though there has since been a rise the charge has not yet reached the old contract rate. Further remark may be deferred till the reader has examined the figures for the City and South London Electric Railway, which are given in Tables III. and IV.

Table III.—City and South London Electric Railway.

Per Train Mile—Pence.

Half-year.	Maintenance of way, works, and stations.	Locomotive and generating power.	Carriage repairs.	Traffic expenses.	General charges, taxes, &c.	Total expenses.
June, 1891...	·53	9·06	·5	8·82	2·44	21·35
Dec., 1891..	·63	7·89	·46	8·1	2·66	19 74
June, 1892...	·56	7·67	·54	7·52	2 89	19 18
Dec., 1892...	·43	7·11	·47	6·78	2 44	17·23
June, 1893 .	·5	6·48	·53	6·39	2·6	16·5
Dec., 1893 .	·6	6·23	·46	6 17	2·35	15·81
June, 1894...	·59	6·22	·41	6 08	2 52	15·82
Dec., 1894...	·55	6 03	·37	5·94	2·47	15·36
June, 1895...	·56	6·1	·45	6·29	2·67	16·07

* Electrical Review, June 20th, 1890.

† The *Railway World*.

‡ Reproduced in the Electrical Review for September 7th and October 19th, 1894.

TABLE IV.—SOUTH LONDON LINE—TOTALS.

Half-year.	Expenses per train mile.	Receipts per train mile.	Per cent of expenses to receipts	Total expenses.	Total receipts.	Miles run.	Passengers carried.
				£	£		
June, '91	21·35	27·02	79 02	15,521	19,637	174,435	2,412,343
Dec., '91	19 74	25·75	76·66	15,516	20,244	188,666	2,749,055
June, '92	19·18	27·33	70·18	15,098	21,520	188,944	2,813,162
Dec., '92	17 23	25·36	67·94	15,390	22,653	214,417	3,217,602
June, '93	16·5	25 54	64·6	14,964	23,159	217,664	3,146,656
Dec., '93	15·81	24·44	64·68	14,762	22,821	224,101	3,093,351
June, '94	15·82	25·6	61·8	14,990	24,295	227,363	3,383,154
Dec., '94	15·36	25·24	60 86	14,762	24,253	230,604	3,275,649
June, '95	16 07	26·11	61·55	15,020	24,402	224,259	3,113,199

These two railways run trains of almost the same weight when all seats are occupied by passengers, but the London line is handicapped by dearer coal and the cost of working the hydraulic lifts at the stations. The benefit to Liverpool, however, is counterbalanced by the fact that its trains are not so well filled. One peculiar point may be noticed, namely, that both lines show a considerable increase in working expenses for the past half-year per mile run, while both (but especially Liverpool) have also increased their receipts per mile. The mileage run in Liverpool is still going up, so that the total net receipts are much better. London is not so flourishing. The Liverpool dividend has now risen to 2¼ per cent., the highest point yet reached.

The only electric accumulator tramway in the country continues its warning to everyone concerned to beware of this method of applying electrical power. Twelve months ago we spoke of the lamentable career of the secondary battery on this line. The additional figures for the year just closed show a further alarming increase in the expenses per car mile, while the receipts show a falling off in spite of a decreased mileage run. The following are the tables. The Corporation charges for maintenance of the tracks, which are not included in the working accounts of the company, but brought instead into their revenue account are here included under the appropriate head, namely, permanent way and buildings :—

TABLE V.—BIRMINGHAM ELECTRIC ACCUMULATOR LINE. PER CAR MILE—PENCE.

Year ending	Electric haulage.	Machinery.	Car repairs.	Traffic expenses.	Permanent way and buildings.	General charges.	Total.
June, 1891	5·15	·29	1·93	1·34	·14	1·05	9 9
1892	5·88	4·03	1·11	1·44	1·72	1·21	15 39
1893	6·1	4·5	·99	1·9	1 63	1·43	16·55
1894	6 0	3·71	·67	1·74	2 21	2·53	16·86
1895	6·59	6 65	1·18	1 61	2·09	2·33	20·45

TABLE VI.—BIRMINGHAM ELECTRIC LINE—TOTALS.

Year ending	Expenses per car mile.	Receipts per car mile.	Per cent. of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
June				£	£		
1891	9·9	15·15	65·35	5,711	8,732	138,396	1,144,718
1892	15·39	13 25	116·15	12,102	10,422	188,760	1,342,997
1893	16·55	16·38	101·04	9,721	9,623	140,993	1,257,399
1894	16·86	16 79	100·42	9,775	9,734	139,123	1,303,833
1895	20·45	15·7	130 26	11,997	9,093	138,925	1,154,3·5

As in past years, the Birmingham Central Company bring directors' fees, secretary's salary, and some similar items into the revenue account. Dividing the total of these items by the mileage run over the company's whole system, steam, horse, cable, and electric, the result is an additional charge this year of ·15d. per car mile. This is considerably less than in former years, as the annexed Table VII. shows. It gives also the real total expenses of the electric line :—

TABLE VII.

BIRMINGHAM ELECTRIC LINE—CORRECTED EXPENSES. PER CAR MILE—PENCE.

Year ending	Total as in preceding table.	Additional expenses.	Grand totals.	Per cent. of expenses to receipts.
June, 1891	9 9	·27	10·17	67·13
1892	15 39	·22	15·61	117·81
1893	16·55	·25	16·8	102·56
1894	16·86	·2	17 06	101·61
1·95	20·45	·15	20·6	131·21

Tramway men will naturally ask how long is this sort of thing to last, and how far is it to be allowed to go? Surely, when the expenses of working a tramway get to more than 131 per cent. of the receipts, and when there is a dead loss of nearly £3,000 in a year on three miles, double track, it is time that something was done. It is true that the Birmingham Corporation refuse to permit the trolley wire, which would pay; but are the resources of the tramway world exhausted? Perhaps the amount of traffic in sight does not warrant the installation of a cable line; but what have the Corporation to say to steam traction. Is the Bristol road too fine for that method also, which reigns supreme over the greater part of Birmingham? The receipts per mile run on the electric line are quite as high as the average on the steam lines of the same company, and could therefore well stand the expenses of 9d. or 10d. per car mile, at which the company's steam lines at present stand. No doubt steam traction is unpleasant in a nice residential locality. But if all things else fail, why not have recourse to the "harmless necessary" horse? A horse line earning 15d. per car mile would be a perfect treasure, but doubtless smaller cars than the present electric ones would have to be used. Still there would be a margin of profit. No doubt the public would at first object to the substitution of horses, as the speed would be lower, but what else can be done? It seems to be a case of either stretch the trolley wire, or yoke the horse.

(*To be continued.*)

ALTERNATE CURRENT MOTORS.

By W. G. RHODES, M.Sc.,
City and Guilds of London Institute. Central Technical College.

(*Continued from page* 224.)

THE solution of the stability problem given in the last article is, as far as the author is aware, new, and should be of practical use to electrical engineers in designing exciting machines for alternate current motors.

Suppose that a motor is built for a particular kind of work, *i.e.*, the driving E.M.F., and the limits between which the output lies are known. We can then calculate the maximum current which will be required to excite the motor field, and knowing the resistance of the field coils, we can obtain the maximum potential difference to be applied at the field terminals, and design the exciter accordingly. Hitherto, in designing exciting dynamos, electrical engineers have depended upon previous experience; but now by formula (14), and the details of the motor field winding, we can design the exciter to have a fixed maximum potential difference at its terminals, and this, combined with previous practical experience, should enable the engineer to reduce the cost of the exciting machine.

In cases where the speed of the exciter can be varied, it will be found useful to construct two curves, one such as is given in fig. 13 (*see last article*), and another a magnetisation curve of the motor field magnets, or what amounts to the same thing, a curve connecting the speed of the exciter with the counter E.M.F. of the motor. Provided with these curves, the speed of the exciter may be adjusted for the most efficient working under any given load; for the first curve will give the counter E.M.F. corresponding to the given load, and the second will then give the speed at which the exciter must be run.

Capacity of the Line.

We have hitherto considered the line as possessing only resistance and self-induction. In the case of aerial lines, these only need be taken into account, as the capacity is then inappreciable. If, however, the line is a concentric cable, its capacity will be considerable, and will cause the current to advance in phase by an amount depending upon the length of the line and its capacity per unit of length. Since the capacity is distributed along the whole line, it cannot be considered as concentrated at any single point, and to give a rigorous and complete investigation of its effects would require difficult analysis, which we do not propose to reproduce here. For a complete discussion in the case of an infinitely long line, we may refer the reader to Chapter 8 of Mr. Blakesley's book on "Alternating Currents."

In order to show what the general effect of capacity is, we give a geometrical discussion. Fig. 14 is fig. 6 altered, to

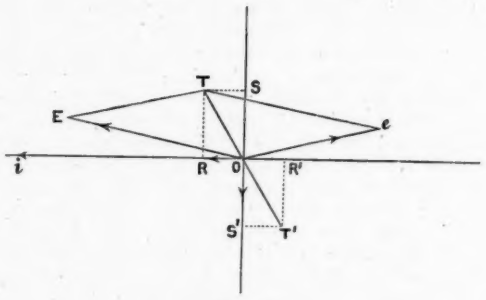


Fig. 14.

allow for capacity. It is known that if $2\pi n$ L is the *reactance* when there is no capacity, then, if a capacity, K, is introduced, there will be an *apparent reactance* given by

$$S_1 = 2\pi n \text{L} - \frac{1}{2\pi n \text{K}},$$

where n is the frequency of the current and L the coefficient of self-induction of the circuit; also, corresponding to impedance, we have apparent impedance given by

$$\text{I}_1 = \sqrt{\left\{\text{R}^2 + \left(2\pi n \text{L} - \frac{1}{2\pi n \text{K}}\right)^2\right\}}.$$

In fig. 14 we have supposed the generator E.M.F. E, the counter E.M.F. e, of the motor, and the current to remain unaltered while the output varies in consequence of the introduction of capacity. O S^1 now represents the difference between the E.M.Fs. required to overcome self-induction and capacity, or

$$\text{O S}^1 = 2\pi n \text{L}\, i - \frac{i}{2\pi n \text{K}}$$

$$= \left(2\pi n \text{L} - \frac{1}{2\pi n \text{K}}\right) i.$$

From the figure we see that as O S [= O S^1] is diminished, O E and O e more and more nearly approach coincidence with the line of current; that is, the component of e directly opposing the current increases as O S diminishes; therefore the effect of capacity is to increase the output for the same excitations of the generator and motor fields. In practice, the output would remain fairly constant, and the current would vary; so that the effect of capacity would be to increase the current flowing in the mains.

In the case of concentric mains the capacity may be considerable; for example, the Ferranti mains between Deptford and London have a capacity of about 0·367 microfarad per mile.

Efficiency.—The efficiency of the motor is

$$\frac{p}{p + i^2 \text{R}}$$

where p is the output, R the resistance of the armature of the motor, and i the current. To make the efficiency high, the resistance of the armature should be small, and the plant should work in the neighbourhood of minimum current in the line for the given output.

It appears from practical results that 3-H.P. machines can be made to have an electrical efficiency of over 85 per cent., and 6-H.P. machines of over 90 per cent., also machines have been made to develop their full rated powers at frequencies of 60 to 80 complete periods per second. The makers claim that the efficiency of these synchronous motors is not exceeded by any known direct current motor of the same output.

We have seen in a previous article that, when working the motor at a slightly higher field excitation than that which corresponds to minimum current, the fields of both generator and motor are strengthened by armature reaction, so that it appears advisable for the armatures of both machines to possess a fair amount of self-induction, not only on account of the strengthening of the fields, but also because, in the case of a breakdown, the counter E.M.F. of self-induction would then prevent too large a current flowing, and would avoid the risk of burning up the armatures.

There are two practical disadvantages attending the use of synchronous motors, viz., the field has to be separately excited, and the motors are not self-starting, but require to be started by some mechanical means; these difficulties preclude the adoption of small synchronous motors for workshop purposes. In the case, however, where large machines are used for distribution of a large amount of power, the above disadvantages are insignificant, for, as Prof. Ayrton and others have shown, there will then be at the receiving station several geared sets of synchronous motors and direct current dynamos, some of which will be running day and night; so that to start any alternate current motor, all that has to be done is to send round the direct current dynamo, attached to the motor to be started, a portion of the current from one of the running dynamos. This will cause the dynamo to run as a motor, and when the proper speed is attained, the alternate current can be switched on to the synchronous motor.

We see, therefore, that synchronous motors have their field of usefulness at the receiving station in long distance transmission of electrical energy. They can there be used for the distribution of electrical energy, either for lighting purposes, or for motive power. It is also worthy of notice that the speed of a synchronous motor can only be altered by altering the frequency of the current, so that for workshop purposes, when the current is obtained from alternating current mains, any single motor is limited to work requiring one particular speed.

(To be continued.)

THE BRITISH ASSOCIATION ADDRESSES.

It has been customary with former presidents of the British Association to describe in a popular way the most recent developments in their own special branch of science. This custom had much to commend it, since it interested and informed the general public, and at the same time supplied specialists in other sciences with a summary of progress in a collateral science by a master hand. So wide and specialised has scientific investigation become in these days, that only an encyclopædic genius could give an adequate account of the scientific progress that has taken place within the last few years.

Sir Douglas Galton has attempted, in his presidential address, to give an account of the progress of the sciences that have engaged the attention of the British Association since its foundation in 1831. The attempt, we think, has not been a success. If he had been content to contrast the state of the sciences then and now, he had the material for a very striking antithesis, but this effect he has spoilt by interspersing his discourse with somewhat fragmentary and imperfect histories of all the sciences, which must, we should think, have been familiar to the most *dilettante* members of his audience. Geology, geography, chemistry, astronomy, physics, meteorology, biology, and engineering were all impartially subjected to the same superficial historical treatment, accompanied with a somewhat exaggerated estimate of the part played by the British Association in their development.

A short history of terrestrial magnetism from Whewell's report to the British Association in 1832 down to the recent investigations by Prof. Rücker, contains no allusion to recent investigations on the magnetic properties of iron, such as those made by Ewing. The remarks on electricity are confined to the statement of a few points in the history of the telegraph and electric transmission of power. The recent great developments of electrical engineering are dismissed in this way :—"The electric light gives, in its incandescent form, a very perfect hygienic light. Where rivers are at hand the electric transmission of power will drive railway trains and factories economically, and might enable each artisan to convert his room into a workshop, and thus assist in restoring to the labouring man some of the individuality which the factory has tended to destroy." The economical driving of railway trains and factories is already a *fait accompli*, without the help of rivers, and it is well known that the river is not of much use for the economical production of power without the big waterfall. That the supply of cheap power will send the artisan back from the factory to the home workshop, is, we think, except in a few special industries, an Utopian dream.

In discussing the history of sewage purification, Sir Douglas Galton does not even mention the Hermite process which is actually being tried in Ipswich. He considers that "electricity as a warming and cooking agent would be convenient, cleanly, and economical when generated by water power, or possibly wind power, but it is at present too dear when it has to be generated by means of coal." This entirely overlooks the fact that electricity will probably at no very distant date be produced by coal in great installations at a small fraction of its present cost.

Sir Douglas Galton next alludes to the influence of the inter-communication afforded by the British Association on science progress. He remarks that "Our meetings have been successful because they have maintained the true principles of scientific investigation. We have been able to secure the continued presence and concurrence of the master spirits of science. They have been willing to sacrifice their leisure, and to promote the welfare of the Association, because the meetings have afforded them the means of advancing the sciences to which they are attached." The success of the British Association, we think, has been mainly due to the fact that it has been one of the most powerful agents in exciting popular interest in the latest discoveries of science, and on this account we hope that the recent rumours of its decline may be falsified.

The president gives an account of how science is fostered by the State and municipalities in Germany, in the course of which he describes that remarkable institution, the Physikalische Technische Reichsanstalt at Charlottenburg, to which there is no corresponding institution in this country. "This establishment consists of two divisions. The first is charged with pure research, and is at the present time engaged in various thermal, optical, and electrical and other physical investigations. The second branch is employed in operations of delicate standardising to assist the wants of research students." The establishment is managed by a council, consisting of the leading scientific and practical men in Germany. Sir Douglas Galton makes the valuable suggestion that the observatory at Kew should be developed on the same lines. The Government in this country, as he shows, really spends already large sums on scientific research and technical education ; but owing to want of proper organisation, the money is very inefficiently employed.

Some interesting remarks are made on the important question of forming a complete index of scientific literature. It is well said that this can only be done by international co-operation. The officers of the Royal Society have already appealed to the Government to urge foreign Governments to send delegates to a conference to be held next July to discuss the desirability and the scope of such a catalogue, and the possibility of preparing it. We hope this project may be carried to a successful issue. Sir Douglas Galton holds moderate views on the subject of the endowment of research, considering that all that is required is a modification and enlargement of some of our present institutions.

While there are some valuable suggestions in this address, as an exposition of the latest advances in science and a literary production, we think it is far below the standard which we have been led to expect from the president of so distinguished a scientific institution as the British Association.

The presidential address to the Mechanical Science Section was given by Mr. L. F. Vernon Harcourt, a gentleman known far and wide for his engineering ability, yet his address may almost be said to offer an argument for the abolition of presidential addresses. The subject of the address was "The Relation of Engineering to Science," a relation too apparent, one would think, to require much comment. Mr. Harcourt has contributed so much to the literature of his own specialty, that any address by him dealing with the progress of those special branches in which he has most experience would probably, as he himself says, be a repetition of what he has already published. As it is, the address consists simply of a series of statements of facts known to most engineers, and having little more than the character of mere platitudes. Thus we are told in the reference to the connection of mathematics with engineering that the laws of statics are involved in bridge design ; under the head of physics, that the spirit level is a physical instrument adapted for levelling across land ; that heat effects have to be allowed for in large structures, and that the Sprengel air pump alone has rendered possible the incandescence lamp. We are informed that gas making is a chemical operation, as also is iron and steel manufacture, and so also is Clarke's water softening process ; that geology is useful to engineers, and so on through a long list of facts of common knowledge, strung together nicely enough and in a form that would have made a capital Sunday school address. One item of fiction we observe, that London has a good water supply. We fear that few of his London listeners would agree with the president in this. London as a fact has not a pint of *organically* pure water supplied to it except by the Kent Water Company, and this supply is overloaded to an unhealthy extent with calcium carbonate. The president put in a word for specialisation, life being too short for an engineer to acquire proficiency in many branches ; and also for the value of congresses such as the six that have now been held on maritime, inland navigation, and water-works subjects, and he would like to see indexes of engineering literature to aid engineers in their search for information. If this is a type of what presidential addresses have come to, we think it would be as well that the presidents of the sections at least should be exempted from the duty of giving a formal address. We may admire the style of the address, and wonder at the ability to put together hackneyed facts in so interesting a manner, and admit that no man could have done much, if any better, but all the same regret that the address is looked for. Mere popular addresses, for to such a class this particular address certainly belongs, would appear to indicate that the British Association meetings are becoming more and more of a social function, that they are to a certain extent partaking of the ladies' idea of Parliament as a means to an end, such end to them being tea on the terrace and similar festivities. We cannot but think that if the sectional addresses were confined to a few words of welcome, supplemented, perhaps, by a special reference to the more important of the papers to be presented to the section, or where it seemed suitable to any special connection between the place of meeting and the subjects dealt with by the section, the result would be much better, and the sectional presidents would be relieved from a duty that must now be extremely difficult to fill in an adequate manner.

THE SNAEFELL MOUNTAIN RAILWAY.

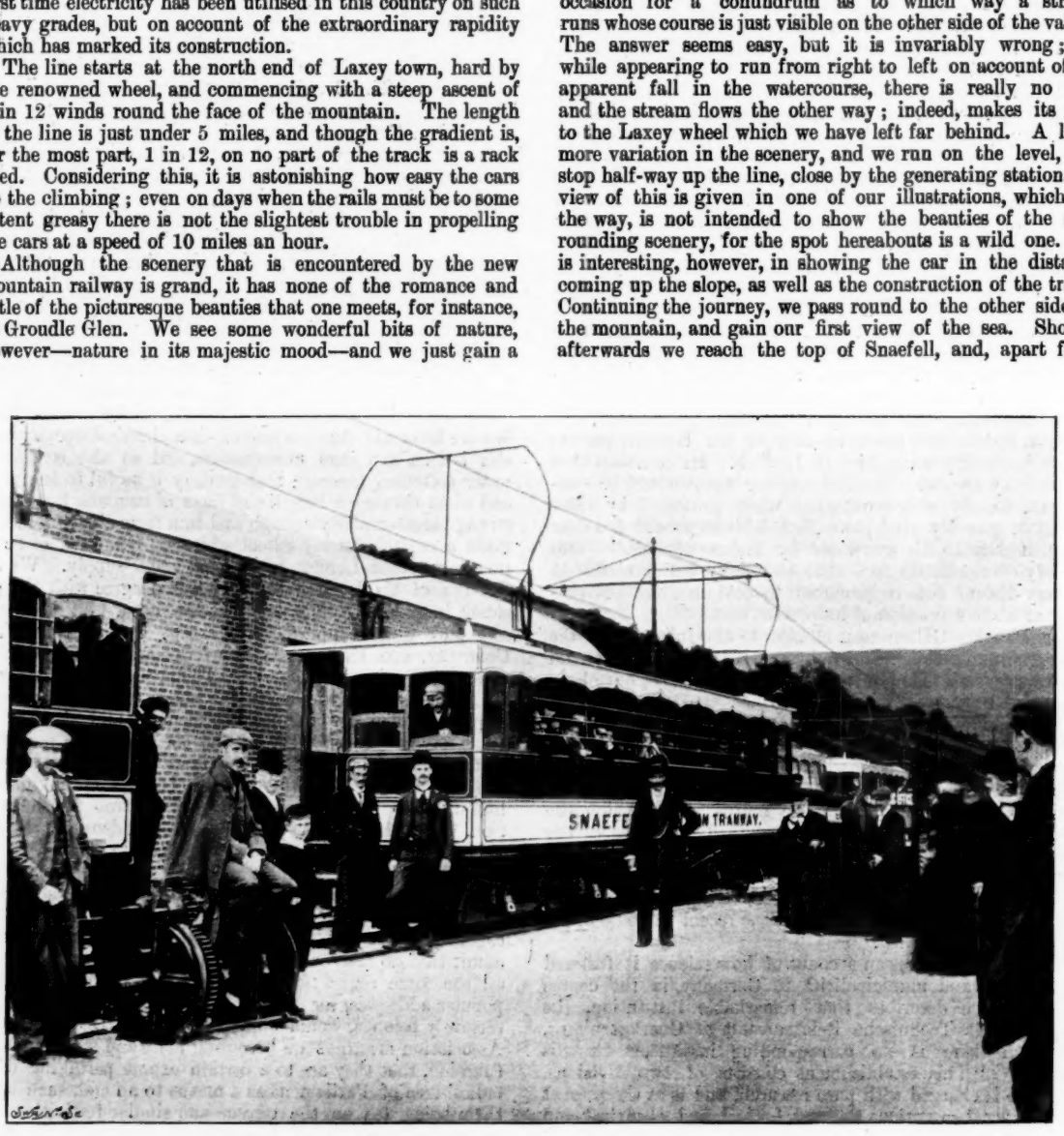
Some few days ago we had the pleasure of travelling over the most interesting electric railway in the British Isles. When we rode over the complete length of the Douglas and Laxey line last year the experience was novel and occasionally exciting, but it fell far short of that gained on a journey up the Snaefell Mountain.

The Snaefell Mountain Railway is not, as has been supposed, a continuation of the Douglas and Laxey Electric Tramway, although the terminus of the one and the starting point of the other are only a little distance apart.

The Mountain Railway is nothing more than a pleasure line, and will entirely suspend operations at the end of the season. The line is interesting, not only because it is the first time electricity has been utilised in this country on such heavy grades, but on account of the extraordinary rapidity which has marked its construction.

The line starts at the north end of Laxey town, hard by the renowned wheel, and commencing with a steep ascent of 1 in 12 winds round the face of the mountain. The length of the line is just under 5 miles, and though the gradient is, for the most part, 1 in 12, on no part of the track is a rack used. Considering this, it is astonishing how easy the cars do the climbing; even on days when the rails must be to some extent greasy there is not the slightest trouble in propelling the cars at a speed of 10 miles an hour.

Although the scenery that is encountered by the new mountain railway is grand, it has none of the romance and little of the picturesque beauties that one meets, for instance, in Groudle Glen. We see some wonderful bits of nature, however—nature in its majestic mood—and we just gain a fleeting glimpse of the famous Sulby Glen traversed by the road to Ramsay, which indicates what one may expect from the summit on a clear day.



Starting Point.

We made the ascent of Snaefell early in the morning, long before the Douglas tripper had spread himself over the land. It was raining hard, and had been doing so since 6 o'clock; indeed, we are quite convinced that much self-abnegation was needed to make the journey under such dismal conditions. It would, however, take a good deal of rain to efface the beauties of Laxey, and one obtains a good idea of the character of the country when standing on the slight eminence at the foot of Snaefell, which serves as the station or the starting point. We take our seats on the car, and little time is wasted in making a start; a short run on the flat enables the car to get fairly under weigh before commencing the climb; 1 in 12, however, makes little difference in the speed of the car, and we rapidly leave the valley behind us. The track is a double one throughout, and the journey up is for the most part on the outside metals; this enables one to make rough calculations as to how far one would roll if certain contingencies were to arise, and the value of *Tit-Bits* in such an emergency occasions earnest speculation. There is very little opportunity to be nervous, however, for the scenery and the line become of engrossing interest. The rise is most marked some quarter of a mile from the starting point, and gives occasion for a conundrum as to which way a stream runs whose course is just visible on the other side of the valley. The answer seems easy, but it is invariably wrong; for while appearing to run from right to left on account of an apparent fall in the watercourse, there is really no fall, and the stream flows the other way; indeed, makes its way to the Laxey wheel which we have left far behind. A little more variation in the scenery, and we run on the level, and stop half-way up the line, close by the generating station. A view of this is given in one of our illustrations, which, by the way, is not intended to show the beauties of the surrounding scenery, for the spot hereabouts is a wild one. It is interesting, however, in showing the car in the distance coming up the slope, as well as the construction of the track. Continuing the journey, we pass round to the other side of the mountain, and gain our first view of the sea. Shortly afterwards we reach the top of Snaefell, and, apart from all technical considerations, the journey was well worth making if only for the wonderful view to be obtained from the summit. Ramsay and the surrounding country lay at one's feet like an unrolled map, while dimly limned in the distance was the coast of Ireland, and the Mull of Galloway just peeped over low-lying clouds. We were told that on certain days the Irish cornfields can be plainly seen; but then the air of Snaefell is exhilarating, and the Mountain Hotel is a capital one. The return journey was quite as impressive as the outward one. Perhaps the most striking feature—not a scenic one, by the way—was the complete control of the car; there was very little variation in speed, the maximum on the steepest grades being never more than 10 miles an hour.

Having dwelt—very inadequately, we fear—on some of the special features of a ride in a mountain car, it becomes necessary to say something about the details of the line. The most astonishing thing about the line is the rapidity with which it has been completed. It was not till January of this year that the contractors commenced to make the road. They encountered throughout the work the most trying weather; they were interrupted time after time, and had frequently to

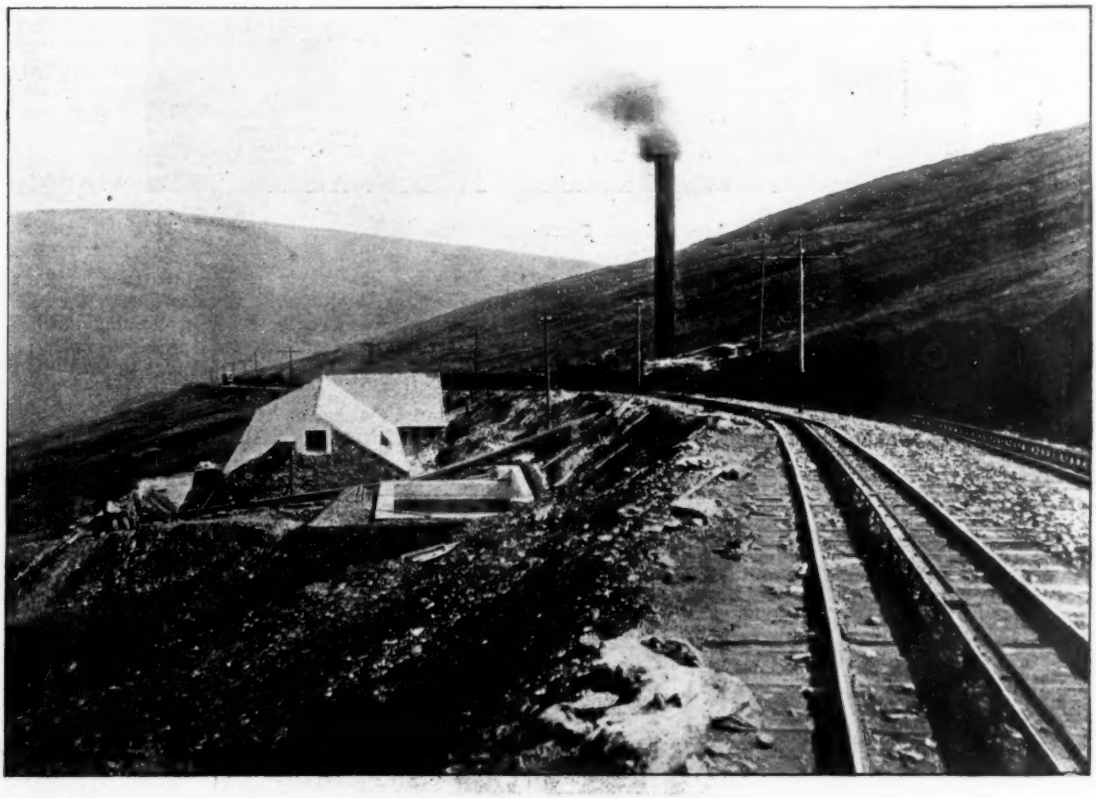
do work twice over. Yet in spite of all these extraordinary obstacles, the work was completed by August 24th—a magnificent performance in every way. Such work has naturally called for great powers of endurance, and all those who have taken part in it, from the highest to the lowest, are deserving of great commendation. We do not think for a moment that the construction has in any way suffered by reason of rapid completion; there is, at any rate, nothing to suggest hurried work. We have already said that the line has been constructed on the face of the mountain, cuttings and tunnels having been avoided in order that an uninterrupted view may be obtained at all points of the line. The permanent way has, for the most part, been excavated, the removed ground being banked to form the outer portion of the line. The varying nature of the soil has, in some cases, necessitated special precautions; but there seemed to be little likelihood of undue strain on the embankment causing anything in the nature of a collapse.

The gauge of the line is 3 feet 6 inches, and as we have already said is double track throughout. The curves are fairly sharp in some places, the greatest curvature being one of a radius of 10 chains. The rails are of cast-steel, and weigh 50 lbs. to the yard. Fish plates are used at the joints, spring washers being used on the fish bolts, and the ends of the rails are secured by fang bolts to the sleepers.

The most novel and interesting feature of the track, however, is the use of a centre rail. This is part of what is known as the Fell system, and is due to Mr. G. Noble Fell, who has laid out and personally superintended the construction of the line. The centre rail is a double headed one, carried on wrought-steel chains. A good idea of this rail will be gleaned from the view of the generating station. The use of this rail is confined entirely to the steep gradients. It may be used for two purposes, tractive and brake. By means of horizontal wheels placed under the car, which are driven by a separate motor, it may assist if desirable in climbing the heaviest gradients, while in descending the centre rail may be gripped by a brake, which is shown in one of our views of the car. Each car carries two pairs of horizontal wheels for running on the third rail, each pair being controlled by special apparatus under the command of the driver. The horizontal wheels are flanged for running underneath the head of the rail, and besides assisting to propel the car they help to prevent the car from leaving the metals. It ought to be mentioned, perhaps, that the "centre rail" of Mr. Fell has been successfully employed by him on a temporary line over the Mont Cenis Pass, and that the system has been much used for the purpose of traversing mountains in South America and New Zealand.

The brake which is so successfully used on the Snaefell Railway is a form of toggle joint, the horizontal motion which gives the gripping property to the brake being obtained from a hand wheel and vertical spindle which is worked by the driver. There is naturally a good deal of surface wearing on the brakes, but they are designed to stand a good deal before requiring to be renewed. While on the subject of the outside construction, we might mention one or two facts concerning the electrical part of it.

It is scarcely necessary to say that the cars derive the electric energy from overhead wires, a slight modification of the well-known Hopkinson collector being employed. The modification consists in making the top part of the rectangle rigid, but we will speak of this when we come to consider the rolling stock in detail. The overhead conductor consist of a No. 3 B.W.G. hard drawn copper wires, which are held by insulators which in turn are supported in clips attached to cross arms on steel poles; the return circuit is through the rails, which are mechanically and electrically bonded. The line is divided into two sections, the voltage employed being 500. At the present moment feeders are not used, though when the traffic has grown sufficiently to demand a more frequent service of cars, they will be laid down. We ought to mention one remarkable thing about the erection of the overhead wires, and that is the incredibly short time that was taken to put them in position. It must be remembered that there are practically 10 miles of wires; yet these, with the necessary poles, were erected in eight days, a truly record performance. If Mr. Willis (who is the resident engineer for Messrs. Mather and Platt) had done nothing but this, he would deserve one's hearty commendation; but we shall have occasion to mention other work which was carried out by him with equal rapidity.

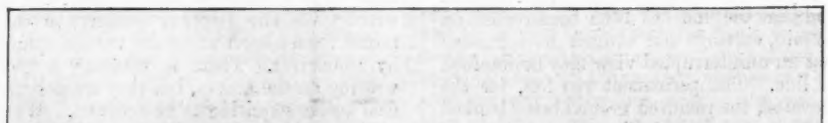


View of Line Showing Generating Station.

The Generating Machinery.

Before going further, we will speak of the generating

machinery. We have already said that the generating station is situate half way up the line. It is no doubt admirably situated with regard to the electrical conditions of the line, but to get the necessary machinery up to such a height was a task of the greatest difficulty. There was only one way of brnging the boilers and engines within measurable distance

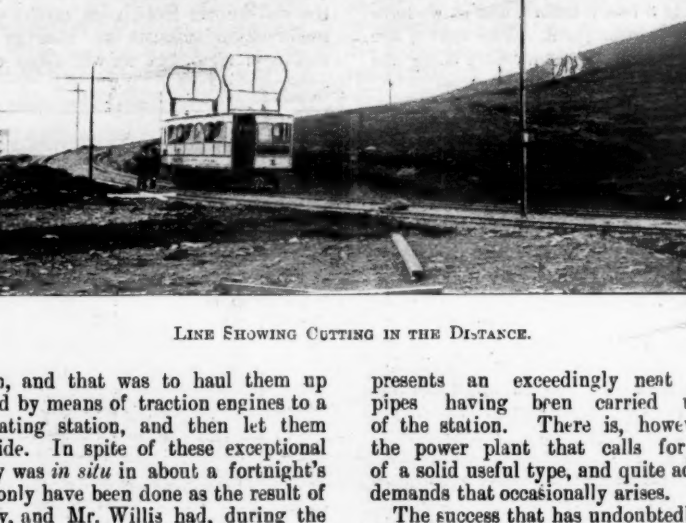


Line Showing Cutting in the Distance.

of the generating station, and that was to haul them up an existing mountain road by means of traction engines to a point above the generating station, and then let them gradually down the hill side. In spite of these exceptional difficulties, the machinery was *in situ* in about a fortnight's time. Such work could only have been done as the result of the most untiring energy, and Mr. Willis had, during the latter days of the construction, an experience that does not often fall to the lot of the electrical engineer. Several nights were spent on the mountain by Mr. Willis, a few hours sleep being obtained in the wooden huts provided for the men, and alternately in the engine house.

The plant at present erected consists of four Galloway boilers, 6 feet 6 inches diameter and 26 feet long, giving a steam pressure of 130 lbs. In the engine room there are five Mather and Platt horizontal compound engines, each indicating 120 H.P. These drive, by ropes and jockey pulleys, five Mather & Platt dynamos each of an output of 550 volts and 120 ampères, when running at a speed of 900 revolutions. The leads from each dynamo are taken to a separate panel on the switchboard, and thence through a lightning arrester to the line wire. The engine room presents an exceedingly neat appearance, the steam pipes having been carried underneath the flooring of the station. There is, however, nothing much about the power plant that calls for special comment; it is of a solid useful type, and quite adequate to meet the heavy demands that occasionally arises.

The success that has undoubtedly marked the use of the chloride accumulator on the Douglas and Laxey line has led



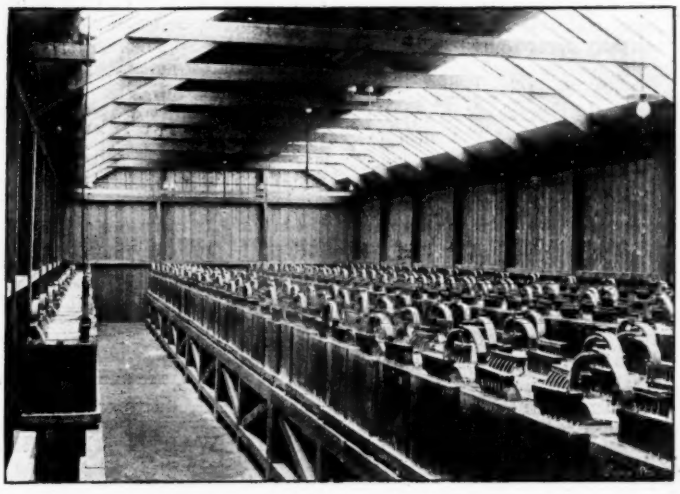
Car on Line Showing Brake.

to the adoption of this type on the Mountain Railway. The accumulator room, an interior view of which we give, is situate at the foot of the mountain, quite near, in fact, to the starting point. It is a roomy and light building, in which are placed 246 accumulators of the patent protected type; they have an output of 176 ampères for 3 hours, 112 for six hours, 84 for nine, and 72 for 12. They are charged by the surplus current from the machines, and discharge in

parallel with the machines as the variation in the demand for current requires.

The Rolling Stock.

Although the cars are of quite a new type, there is nothing, save the arrangement of motors, to mark a difference between them and the cars on the Douglas and Laxey line. They are of the open type, and are designed to carry 50 people, including the driver and conductor. Each car is fitted with four series motors, similar in design to those used on the Douglas and Laxey line. The cars are carried on two bogies. The motors are geared with single reduction steel gearing, and fitted with carbon brushes, the working parts being adequately protected in a box arrangement. A controller switch is provided at either end of the car, so that the car can be driven either way. Each controller is provided with an interlocking arrangement which prevents reversal of a car when current is on. The total horse-power of the car motors is 100 H.P., the car having a tractive force of 3,500 lbs. A sanding arrangement is provided with each car, which is under the control of the driver. We have already spoken of the horizontal wheels which are carried underneath the car for the purpose of engaging on the centre rail as well as the braking arrangement. There are six cars in use at the present moment. It will be seen from the horse-power required by each car that considerable expenditure of energy is necessary to drive the car to the summit of the mountain. There is little fear, however, that the line will not be a paying one, for though the line has not been opened more than a few weeks it has already become exceedingly popular with the visitor. The fare charged to the summit of the mountain and back is 2s., and when we mention that on one day during our visit 900 passengers made the ascent, it would not be rash to prophesy a prosperous career for the new line.



Accumulator Room.

It takes about 27 minutes to ascend the mountain, which gives a rate of travelling of nearly 12 miles an hour, and this when the car is full.

The point which struck us as of supreme interest was the ease with which the cars at all times took the gradients of 1 in 12. We are quite aware that ordinary adhesion methods ought to do something equivalent to this, but when such a gradient continues for nearly five miles, it must constitute a very severe test.

The completion and the successful working of the first mountain railway by electricity will, we think, be of immense importance, especially when considered in conjunction with the light railway problem. It would be perfectly easy to tap isolated neighbourhoods by means of a line similar to the one at Snaefell. Its construction would cost very little more than a steam road, while the working expenses would be much lower. The total cost of the Snaefell line—and one has to consider the natural difficulties that existed—does not much exceed £40,000. Such a sum would go a long way towards laying down a line over a country which was not mountainous.

As we have already pointed out, the line is merely intended for pleasure purposes, and will lie idle during the winter months. There is little prospect of obtaining winter traffic even if the line were extended. It is reasonable to suppose that the coming winter may cause some considerable expenditure in getting the line into working condition for next season, but save on the overhead lines there should not be over much deterioration.

MEASURING THE VELOCITY OF PROJECTILES.

During the last few months some experiments in measuring the velocity of projectiles by means of a new apparatus have been in progress at the United States Artillery School, Fort Monroe, Va. The instrument used is based on a modification of Dr. A. C. Crehore's reliable method of recording variable current curves. A little reflection will satisfy anyone that an instrument for measuring a variable current possesses the essentials of a chronograph, and a chronograph is the essential instrument for measuring the velocity of projectiles. A good current measurer must give sufficient data to construct a curve, the horizontal axis representing time, and the vertical axis current. The time intervals between any phenomena can therefore be measured by such an instrument, if the phenomena referred to are capable of either interrupting the electric current or changing its strength in any way.

It is presumed that our readers are familiar with Dr. Crehore's method of recording variable current curves. It was duly described in these pages, and a full description of it can be found in the *Transactions* of the American Institute of Electrical Engineers, October, 1894. For the purpose of a chronograph Dr. Crehore's instrument has been simplified by omitting that part of it which produces the spectrum and by making it record instead the persistence and the interruptions of the white light emerging from the analyser. This modification permits it to record the passage of a projectile at a number of points of its trajectory. These points may be as near together as is convenient. In the experiments at Fort Monroe they were all within 45 feet of the muzzle of the gun, because it was determined to study the law of variation of the velocity of the projectile near the muzzle.

This method of measuring the velocity of projectiles is the same in one essential particular as the methods practised in England. The projectile passes through screens placed at stated intervals in the course of its flight, and the velocity is obtained from two independent measurements of the distance between the screens and the time interval. As a chronograph the instrument has obviously a wide application to many phenomena of nature, besides the single application to the measurement of the velocity of projectiles.

It is clear that a chronograph must consist of two parts, a transmitter and a receiver. That is, there must be some agent which can transmit from the phenomenon to be recorded, wherever it may be located, the occurrence of the event to a place where it can be permanently made a matter of record; whilst, in the second place, the agent which is to receive the record must include with it some accurate means of measuring time. The particular form of transmitter used in these experiments (which we might add were conducted by Dr. Crehore and Mr. Squier, and are fully described in the *Journal* of the United States Artillery, July, 1895), depends for its action upon the use of polarised light.

In order to understand the *modus operandi* let us follow through the following argument: Let us admit a beam of sunlight through a small aperture into a dark room and let it fall upon a sensitised photographic plate. If the plate is moved transversely across the beam it will be found that the negative shows a continuous band of light. Now, suppose that the aperture which admits the beam is provided with a shutter that can be opened and closed at will. As the sensitive plate moves across the beam let the shutter be successively

opened and closed. The negative now shows an interrupted band of light alternately light and dark, due to the opening and closing of the shutter. If the beam were admitted to the plate through a narrow slit it would be possible to make the band of light step off suddenly at a definite point on the negative. If it is known just how fast this sensitive plate moves across the beam, it would be easy, by measuring the distance between two points on the plate, to measure the time intervals between the opening and closing the shutter. Again, the shutter might be operated by some agent whose time interval we desire to know, and thus a measure of it is obtained. If the shutter could be manipulated quickly enough by a projectile, we might thus measure its velocity. But if we should attempt to make any *material* shutter, that necessarily possesses a certain amount of *inertia*, move back and forth at the instant the projectile passes a screen, we must surely fail. The experiment is more successful, however, when we use a shutter that has absolutely *no mass*. This is the kind of shutter which was used in these experiments, and it was with this object in view, to obtain a massless shutter, that we have made use of polarised light.

In the path of the beam of white light admitted through the aperture is placed a Nicol prism in order to obtain a beam of plane polarised light. An analyser, consisting of a similar Nicol prism, is placed in line with the polariser. As the analyser is rotated about the axis the transmitted light varies in intensity from total extinction in one position to maximum brightness 90 degrees from it. The analyser as used for the chronograph is permanently set for total extinction.

In order to accomplish the same end that is obtained by rotating the analyser without actually doing so, the following means is adopted: Between the polariser and analyser is placed a transparent medium which can rotate the plane of polarisation of the light subject to the control of an electric current without moving any *material thing*. The medium used in these experiments was liquid carbon bisulphide, contained in a glass tube with plane glass ends.

It only possesses this necessary rotatory property when situated in a magnetic field of force. The rotatory power is proportional to the intensity of this magnetic field.

To produce a magnetic field in the carbon bisulphide, a coil of wire is wound around the glass tube and an electric current passed through the coil. When the current ceases the carbon bisulphide instantly loses its rotatory power. The operation is as follows: First the polariser and analyser are permanently set in the crossed position, so that no light emerges from the analyser. A current is now sent through the coil on the tube. The plane of polarisation is rotated. This is equivalent to rotating the polariser through a certain angle, and hence light now emerges from the analyser. A current is now sent through the coil on the tube. The plane of polarisation is rotated. This is equivalent to rotating the polariser through a certain angle, and hence light now emerges from the analyser. Break the current, the medium loses its rotatory power, and there is again complete darkness. This arrangement makes an effectual shutter for the beam without moving any mass of matter.

It is clear that the whole time of transmitting the phenomenon to the receiver may be thought of as consisting of three distinct operations which occupy three successive intervals as follows:—(1) The interval due to change in current. (2) The lag of the magnetic field in the solenoid behind the current which caused it. (3) The time occupied by the rotation of the plane of polarisation and the transmission of light from the transmitter to the receiver.

The receiver is that part of the chronograph which is susceptible of receiving the continuous record from the transmitter, and it also includes that part of the instrument which measures time. In these experiments it consisted of a circular photographic plate upon a horizontal shaft in a dark box. An approximately uniform rotation was given to it by means of an electric motor, whose armature was coupled directly to the shaft. In order to accurately determine the angular velocity of the plate whenever it is exposed, a tuning fork is placed so that the shadow of one prong is projected sharply upon it by means of a parallel beam of light from an intense source. The light from the transmitter, as well as the light from the tuning fork, is admitted to the plate through a narrow horizontal slit. When the plate is in rotation, and the tuning fork is vibrating, the shadow of the edge of the fork describes a sinusoidal line around the plate. From a knowledge of the angle on the plate which a certain number of these waves subtend, and the time of vibration of the fork, the angular velocity of the plate at once becomes known. The real time measure is thus a tuning fork, which is a most reliable method of measuring time. Moreover, the speed is in each instance recorded upon the plate, so that the necessity of measuring the speed before and after the observation is avoided.

The receiver is a photographic means of recording the intermittent beam of light through the analyser, and consists of a camera containing a sensitised plate. In the original paper minute details with diagrams are given showing the whole arrangement.

The velocity of the projectile is obtained from the measurement of these quantities, namely, the distance between the screens, the angular velocity of the plate, and the angle through which the plate revolves while the projectile passes between the screens.

The experiments described in detail in the original paper, justify one or two conclusions: This chronograph, as thus far developed, has clearly demonstrated its important field of usefulness for the accurate measurement of small intervals of time. The record made by a break in the current due to the passage of the projectile, is sharper and more defined than was anticipated, and this permits of an accuracy in reading the record even beyond that attainable in measuring the intervals between screens on the proving ground. A future working instrument designed upon this fundamental principle is capable of endless modification, and an instrument properly designed would be as simple in its operation as any of the well-known chronographs now in use. The whole is manipulated by a single switch, which fires the gun and obtains the record.

The adaptability of this instrument for obtaining observations at any number of points of the same trajectory and the nearness which these points may have to each other, make it admirably suited to the study of the law of change of velocity near the muzzle of the gun, and also to the systematic study of the law of the resistance of the air to projectiles of various forms; a problem which, since the advent of the modern high-power gun with its realm of velocities unthought of in the classic experiments of Bashforth, is at present of paramount importance to the science of *exterior ballistics*.

THE WASTE OF CHEAP MATERIALS.

In a note on another page some attention is drawn to the great difference in the consumption of fuel that a fireman was able to effect as between one day and the next under practically identical conditions. In processes usually termed chemical, a given quantity of a drug is expected to be sufficient for a certain process. Quantities are equated by their chemical formulæ, and if any serious difference was observed, there would be trouble, and blame would be apportioned, for the reason that ordinary chemical raw materials cost money. In some way or other the chemical processes of the furnace have been neglected, perhaps because the largest element which is employed is at once both invisible, and costs nothing. We refer, of course, to the air which supplies the oxygen necessary for combustion. While costing nothing, there is needed something like 12 lbs. of air to provide the oxygen necessary to burn each pound of coal. Because it costs nothing, there is very little care exercised in its use. Were it absolutely necessary, in order to burn coal, to supply air at a pressure of, say, 5 lbs. above the atmosperic pressure, it would long have been found necessary to use the minimum of air, as it would, also, if air had to be purchased at so much per thousand cubic feet. Yet without these promptings, there are facts quite sufficient in themselves to call for the economical use of air. It ought to be clearly understood that the efficiency of a furnace does not depend on the brilliance of the combustion, but upon the proportion of heat absorbed by the boiler; and as there is a minimum below which the boiler cannot reduce the temperature of the gases resulting

from combustion, it is of first importance that the weight of escaping gases should be a minimum. Under certain quite ordinary conditions the escaping gases go off to the chimney at a temperature about one-fourth that of the furnace. They carry with them about one-fourth of the heat generated in the furnace; but if the air used under these conditions be double the theoretical minimum, it is easy to see that one-half the wasted heat would be saved if the air were cut down to its minimum, so long as the final temperature were the same, and this would be easier to secure than where the heat was diluted in double the bulk of the gases. Furnace and boiler efficiency is, in fact, simply a question of air supply. One pound of coal is wasted for, approximately, each 100 lbs. of excess air, measuring, at ordinary temperatures, 1,300 cubic feet. With coal at 7s. per ton, air thus costs a steam user about 3d. per 100,000 cubic feet, and as each ton of coal is quite usually burned with an excess of air of 350,000 cubic feet, the waste of air per ton of 7s. coal amounts to 10½d., or including wages for shoveling on the coal to heat this air, and to wheel away the extra ash and clinker, we may say 1s., which totals up to £150 per annum. So far then from air being an article that costs nothing, it really costs the steam user about one-tenth of 1 per cent. of the price of London gas, and as it is used in such enormous volumes, its total cost is a very serious item, and air should not be wasted. Air is already so dilute a mixture of oxygen with inert nitrogen, that at best it carries off a lot of heat that would be saved could we use pure oxygen in our furnaces. When to this unavoidable loss we add a further 100 per cent., the total loss is very great, and attainment of a 12 lb. evaporation is indeed a great result to obtain with such impure chemicals. At the same time the power of saving air is in the hands of the fireman, and there are few places where there is not a large fund out of which a substantial bonus could be paid for saving air. The saving of air is but a synonym for a large percentage of carbonic acid in the flue gases, and instruments are now made which will show this percentage at any time, and could be made even self-recording. Such an instrument is thus simply a meter of carbonic acid, whereby we may be able to pay piece rates to the man we employ to manufacture this gas. But our object is not to manufacture carbonic acid gas; all we wish to do is to manufacture a minimum quantity of flue gases containing a maximum ratio of carbonic acid. In paying piece rates for this work, therefore, it becomes necessary to employ, on the one hand, a water meter, and, on the other, an econometer, paying per thousand gallons evaporated a fixed rate, with an addition based on the *ratio* of CO_2 in the chimney gases. Absolute minimum of air might be represented by an addition of 50 per cent., and the ordinary excess of, say, 10 lbs., by 0 per cent.; each lb. less of air per pound of coal representing 5 per cent. addition to the standard pay, while beyond 10 lbs. excess the pay would diminish 5 per cent. per pound. This question of economical fuel consumption seems one particularly suited to payment by results, for in a given steam plant it is so easy to know what is usually done, and what is the maximum that can be done, and to pay per ratio of CO_2 is probably fairer than to pay per evaporation per pound of fuel, for the quality of the fuel has less effect on the ratio of CO_2 than upon the evaporation. The only check needed is that upon waste at the safety valve and other points, and this is, obviously, to be performed by the engine room staff, whose interest it should be made to secure the best ratio between total electrical, or other output, and water consumption. Good firing may be summed up in the one item of a proper air supply; this being, practically, the only thing that need be considered.

NIAGARA.

We reproduce the following correspondence from the *Times* of Tuesday and Wednesday last, without any comment further than the remark that we shall await with intense interest Prof. Forbes's reply. So far as Mr. Stetson is concerned one has only to read the Niagara number of *Cassier's Magazine* to arrive at the condension that the less he says better.

To the Editor of the *Times*.

Sir,—Our attention has been called to a communication under date of July 15th from Prof. George Forbes, published in your columns. In view of the amazing statements of Prof. Forbes, we desire to give a few facts.

This company was not a submitter of plans in competition with others (as was Mr. Forbes) for prices offered by the Cataract Construction Company in 1890, and it was not until a much later period that we became aware that Mr. Forbes had been a competitor, and was continuing to labour for the honour of furnishing an acceptable plan for the transmission of power from Niagara Falls to distant points.

At the period named, we were convinced that such transmission was not possible, except by means of Mr. Tesla's great discoveries, whereby alternating currents of two or more phases could be used successfully for such purposes, and we naturally preferred to defer the submission of a plan until the Tesla inventions could be more fully adapted to so large an undertaking.

After a lapse of two years, and prior to the design of the dynamo referred to by Prof. Forbes, this company submitted to the Cataract Construction Company plans and specifications for a dynamo, with a system of distribution for the operation of arc lights, incandescent lights, street cars, and for electrolytic purposes, including rotary transformers. Full information and particulars were communicated to the engineers and officers of the Cataract Construction Company. Owing to the purloining of our plans by a rival company, and for other reasons, all tenders for generators were rejected by the Cataract Construction Company, who afterwards, in September, 1893, submitted to us plans for a 5,000-horse-power generator, saying that such plans had been prepared by their engineers, and asking us to make a tender for its construction and erection. A careful consideration of the plans submitted disclosed the fact that if constructed according to such plans, the generator would be a failure, and this company thereupon refused to tender onthe drawings and specifications presented. We, however, offered to accept the general form of generator, and to re-design it so that it would be a perfect machine, mechanically and electrically, and to submit new plans and specifications upon which the company would tender. This was agreed to by the Cataract Construction Company, and the generators now in use at Niagara Falls were built by us according to plans and specifications prepared by our own engineers. There is about the same difference between the machine designed by Prof. Forbes and that designed by us as there is between the picture of a man and the man himself—the appearance externally being very similar, but internally there is no resemblance whatever.

Business relations were established between Prof. Forbes and this company in 1888 by the purchase of his patent for a meter operated by hot air currents, and he was afterwards employed by us as an expert in a patent case and in making tests on transformers. He thus had every opportunity to become acquainted with our practice and ideas in connection with the use of alternating currents for light and power purposes, and also had an opportunity to see considerable of the early work on the Tesla motors. That such opportunities were valuable to him is shown by the fact that the first plan submitted by him for the transmission of power from Niagara Falls was almost identically on the lines that we had laid out for such work and freely discussed with him.

The following letter was received from Prof. Forbes about October 1st, 1891:—

"34, Great George Street, London, S.W.,

"September 19th, 1891.

"Dear Mr. Westinghouse,—I am going to read a paper on alternate current motors. I want to emphasise the importance of your work on the Tesla motors. May I ask you kindly to allow me to have as full information as possible by instructing one of your staff to forward some details? I daresay you cannot give me all the facts I want, but if I indicate them generally perhaps you will give me some of the points. First, and most essential, I want a drawing to show the winding of the armatures, especially the unsymmetrical winding, which I saw last year. I should also like to have drawings of the complete machines, generator and motor. The dimensions, weight, speed of revolution, output, and efficiency of any particular machine that you have made. What are the largest and smallest machines you have had giving good results? What is the period of alternations and E.M.F. you have used? What examples may I quote of their successful use in practice? I know that the development of the motor has been retarded by other than engineering difficulties. I am glad to learn that the financial difficulties of the company have been surmounted.

"With kind regards I am yours most truly,

"George Forbes.

"P.S.—I also want facts about the power when starting the motor."

To which reply was made as follows:—

"Pittsburgh, Pa., October 30th, 1891.

"Prof. George Forbes, 34, Great George Street,
London, S.W., England.

"My dear Sir,—I desire to apologise for not having written earlier in answer to yours of September 19th. I have given the matter very full and careful attention, and I have come to the conclusion that our company cannot afford at this time to make public the information it has acquired in its work on the Tesla motor. The Tesla patents and discoveries include many very important matters, and his patents particularly cover the multiphase forms of motors and generators now attracting so much attention.

"You must have become aware that patent rights are no longer respected in this country; that whatever is brought out and fully explained is immediately availed of by unscrupulous competitors; and we now feel it is a matter of great importance to maintain for the present, and until we are well established, what are properly secrets of the trade. To no one would I sooner give the information asked for than to yourself, and I hope the day is not far distant when we will be able, with safety to ourselves, to meet your wishes in this respect.

"Trusting that you will appreciate the reason given for not promptly complying with your request.

"I am very truly yours,

"Geo. Westinghouse, Jr."

In consequence of Prof. Forbes having written the foregoing letter without stating that he was a competitor for the honour that would accrue to the successful designer of a complete plan, our company, for that and other good business reasons, refused to permit Prof. Forbes under any circumstances to visit its works or to have anything to do with the designing, constructing, or testing of the generators, and we are not aware that he has ever seen the apparatus which is now in operation at Niagara and for which he seeks to claim the entire credit.

In conclusion, we desire to state that a complete plant, showing the universal application of the alternating multiphase apparatus, was erected in our works for the especial benefit of the officers and engineers of the Cataract Construction Company in the fall of 1892, which Prof. Forbes did not see, but which was undoubtedly explained to him, and which he had an opportunity afterwards to inspect, and did inspect, in our exhibit at the World's Fair, Chicago, in 1893. In this exhibit generators, motors, and rotary transformers were operated at 3,600 alternations per minute, being practically identical with the frequency actually adopted at the Falls, and very different from Prof. Forbes's recommendation of about 1,000 alternations per minute.

Prof. Forbes made a suggestion for a device for commutating currents, in place of a rotary transformer, which device was built, and upon test the fact was disclosed that it was not anything like as good as the rotary transformer which we had designed and which form was afterwards adopted by a rival company, as Mr. Forbes says, on his recommendation.

We regret that there is occasion for stating the foregoing facts.

Yours truly,

Westinghouse Electric and Manufacturing Company

(Geo. Westinghouse, jun., President).

Pittsburg, Pa., August 29th.

To the Editor of the *Times*.

Sir,—In the *Times* of to-day appears a letter from the Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., on the above subject. As silence on the part of Prof. George Forbes might be liable to misconstruction, I beg that you will permit me, his private secretary, to mention that he is far away from England, on a journey to South Africa on an important engineering work, and, consequently, it must be some weeks before he can have the opportunity of replying to the Westinghouse Company's letter.

In the meantime, I may, perhaps, be permitted to quote two extracts from letters written by (1) the Cataract Construction Company, through its president, Mr. Edward D. Adams, to Prof. Forbes, in November, 1894, and (2) the first vice-president of the same company, Mr. F. L. Stetson, which appeared in your columns of the 3rd ult., which I think sufficiently meet the principal contentions of the Westinghouse Company. Mr. Adams wrote:—

"We further recognised that, in the advocacy of the use of the alternating current and of low frequencies, you were a pioneer, and we join you in the feeling of just satisfaction at the conclusion which has now been reached in respect of those features. In this, too, your independence of thought and action has been of particular service, while, through your original design of the stationary armature and revolving field of the generators, adopted by us, you have relieved us of one most embarrassing question in connection with the relation of the generator to the turbine."

Mr. Stetson, in your columns, said:—

"But the development of our plan must have been long delayed had it not been for the courage and comprehensive knowledge of Prof. Forbes, who alone stood for the absolute commercial advantage of the alternating current, and for his admirable conception of his 5,000 horse-power dynamo, so wonderfully worked out by the Westinghouse Company as to yield 5,315 horse-power in the actual test on June 28th, 1895.

"Prof. Forbes is entitled to the credit, as he must bear the responsibility, of the results of the advice given by him as to the three points stated in his letter of July 25th; and we have followed his advice, perhaps not as far as his courage would carry him, yet beyond the former practice of the manufacturers, who now fully concur in the wisdom or his recommendations as adopted."

Two of the three points referred to by Mr. Stetson (which alone need be quoted here), as stated in Prof. Forbes's letter in your issue of July 27th, are:—"(1) The selection of alternating currents, and (2) the reduction of speed of alternations as low as was possible."

I am, Sir, your obedient servant,

Herbert E. Mitchell.

34, Great George Street, Westminster, S.W.,
September 10th.

THE ELECTRIC LIGHT AT FOLKESTONE.

The Folkestone Corporation on Tuesday held a meeting to discuss the electric lighting scheme put forward practically by Mr. F. H. Medhurst. Some time since a scheme was introduced by Mr. Mark Parker, the cost of which would be £35,000. Councillor Baker was instrumental in overthrowing this, and promised to bring forward as good a scheme, at a cost of £12,000. After some delay he brought it before the corporation in June, but the General Election caused the discussion to be delayed, and it was not till Tuesday that they were able to hear it. The system recommended by Mr. Medhurst was the high tension alternating current system, with transformers in sub-station, and a low tension three-wire network of mains for private supply. There would be three transformers in sub-stations, consisting of underground watertight vaults or cellars. Public lighting would be confined to the Leas from end to end, by means of a rectified current and 22 arc lamps were to be used of 2,000 nominal candle-power, the lamps being 150 feet apart. The machinery at the generating station would be able to maintain 4,500 lights of 8 candle-power, exclusive of the Leas light. The plant would consist of two water-tube boilers of 140 horse-power each, three steam alternators of 60 kilowatts, a 16-H.P. gas engine, &c. Distribution would be effected by stranded copper cables, drawn into cast-iron pipes, with junction boxes at intervals. The probable revenue is assumed as 10s. per lamp per annum, and is, therefore, estimated to produce £3,000 from private, and £730 from public lighting each year. The cost of plants, mains, &c., is fixed at £12,910, and the working expenses at £2,936, leaving an estimated profit of £794. Power was to be asked for to borrow £15,000. It was advised that Mr. Medhurst be retained to superintend the work.

Councillor Baker introduced his scheme, and proceeded to condemn that put forward by Mr. Mark Parker. This was resented by Councillor Thompson, who really brought forward the Parker scheme, and the Mayor requested Mr. Baker to confine himself to Medhurst's. The Mayor's ruling produced some hot protests, but Mr. Baker promised to obey, although he alleged he was being unfairly treated. Mr. Baker said he desired the Corporation to execute the work to stop a company coming in. He admitted the strong opposition of the incandescent gas light. He estimated a profit, but electrical engineers were always sanguine, and there might be a loss. He claimed that the area over which his scheme was proposed to go was a more profitable one than Parker's, and it was cheaper, because they only proposed to put in the absolutely necessary plant. It would be ample for many years, taking other towns as a comparison, at any rate until the population was 35,000. When larger machines were needed they could be put in at no loss whatever. He defended the system of putting the cables in pipes, and said Parker's idea of laying mains was "barbaric." He moved that the report be adopted.

Mr. Payer seconded. He said he had been in favour of Mr. Parker's scheme, but the public would have nothing to do with it, and he should therefore support the present one. The effect of the two schemes would probably be that a company would come in.

Mr. Thompson read a carefully prepared speech criticising Medhurst's scheme very fully. He alleged that Mr. Medhurst was not qualified to take the superintendence of works such as were proposed, by reason of lack of experience. He gave some details of his connection with electricity, alleging that the only place where he had had control was Bedford, where he had put in one of the smallest plants in the kingdom. He offered to give them an installation of 190 kilowatts for £12,900, yet at Bedford an installation of 100 kilos. cost practically the same. He had calculated his revenue on a basis of 32 watts 8-candle-power lights, and only intended to put in 24 watts. Mr. Thompson contended that Medhurst's consumption of fuel would be 50 per cent. more than he had estimated. The only place where the light was produced at 1d. per ·63 of the Board of Trade unit was at Portsmouth when very best machinery was used, yet Medhurst said he could do it here, although at Bedford it cost 2¾d. The plan of putting down the cables was wrong because when they desired to extend they would have to be taken up, while, under Parker's scheme, they would not want touching, and his weight of copper mains per mile was four or five times as much as Medhurst's. To try and effect a compromise, Mr. Thompson proposed to refer both schemes to Mr. Manville.

Mr. Spurgen moved that they be referred to *an* expert.

Mr. Jones said he should support Medhurst's scheme, although he did not think the public in Folkestone wanted the electric light. After a somewhat acrimonious discussion, it was resolved that the whole matter be adjourned *sine die*.

CORRESPONDENCE.

Radius of Brake Strap.

I am much obliged for the information contained in your latest remarks on the above subject, but there are still one or two points on which I am not perfectly clear, and you surely will not deny a few additional lines of explanation to one who has so humbly donned the white sheet of penance.

In my first letter I asserted that with a flexible band (I did not say or mean one with theoretically perfect flexibility—that was a creation of your own imagination) the weight

would hang directly below the surface of the rim. You admitted that this would be so with a perfectly flexible band, but asserted that there would be sufficient elasticity in an ordinary rope to deflect the weight from this position through a distance equal to the radius of the rope, and in this way you accounted for the position in which it would undoubtedly hang, at a horizontal distance, R + r from the centre of the wheel.

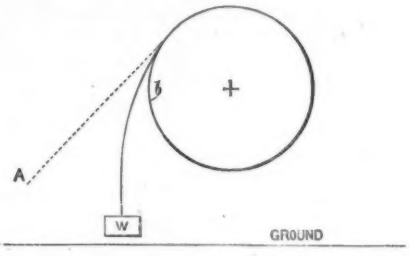
Now permit me to suppose again for a moment the case of a perfectly flexible band of material thickness (as you appear to be unable to conceive of a flexible band apart from the somewhat uncommon quality of infinite thinness, I may mention a chain as a tolerable approach to it), I am quite sure you will not deny that with such a band the weight would hang, not below the surface of the rim, but at a distance from it equal to the radius of the band, *i.e.*, at a distance R + r from the centre of the wheel. Now add to the perfectly flexible band those peculiarly elastic properties which are possessed by the ropes which occur in the neighbourhood of Paternoster Row, and—Hey! Presto! what have we here? On your own showing the elasticity of the band deflects the weight through a further distance, r, and we find it hanging at a horizontal distance, R + 2 r, from the centre of the wheel. Is this reasoning correct, or is that same white sheet interfering with the clearness of my vision?

Your remarks as to my "entire misunderstanding of the whole scope and meaning of the question," I pass by as one of those useful generalities which people with a character for omniscience to maintain are apt to employ when the same is called in question. In the course of the discussion you have made one or two obvious and undeniable slips which it has been my pleasure to point out, and which no amount of wriggling can cancel. That it should be so has surprised me the more, owing to the extreme care which almost invariably characterises the statements in your valuable paper, and I am only able to account for it on the supposition that that portion of the editorial staff which ordinarily overlooks the omniscience department has been taking its holiday.

E. G. Herbert.

Manchester, *September 7th*, 1895.

[Our correspondent appears to be getting angry. If, as he says, he did not mean a perfectly flexible band, why did he claim a property which could only be supposed to attach to such a band? We were talking of ropes bent round a circle, and therefore with some tendency to straighten themselves out, and our contention that a rope with such a tendency would help to throw a suspended weight out of the perpendicular, was just as much a matter of plain fact as that a girder will lose some of its deflection when relieved of loading. Mr. Herbert now puts forth a proposition for a jointed band, which he asks us to conceive as being perfectly flexible and of material thickness, and then, forsooth, he asks us to allow this bicycle chain, as we may term it, to become a solid structure free from joints, or *elastic*. Now, he cannot have both suppositions together. Let him stick to possibilities and not endeavour to pin us to a statement of radius based on two incompatibles. Mr. Herbert began his first letter by accusing us of error. He still claims to have discovered we have made "undeniable slips," much as his supporters discovered him to have written an "unanswerable letter." We are not omniscient by any means, nor did we think it required any of that quality to know that the velocity of a belt upon a pulley is not measurable by the circumference of the pulley. Mr. Herbert still grudges the correctness of the French practice we upheld, even after he has once confessed we did right to do so. We entirely fail to see what it is he is driving at in his letter above. If he cares to put this down to our lack of omniscience, pray let him do so. At the same time, if, without imputing to us what we have not said, he will point out the "one or two undeniable slips" we have made (Is it one, please, or two?) we should be pleased to insert his letter. We think we have already shown that the fancied slips he has pointed out were phantoms of his own creation, evolved, like the jointed spring above, from the realm of the unpractical and impossible. We must, however, distinctly deny that we claimed the radius, R + r, of a brake strap to be due to the elasticity of the rope in the way suggested by Mr. Herbert. The second paragraph in his letter is a direct misstatement of what we did say, which was plainly enough that the weight would hang at about the centre line of the rope—actually, of course, at or near its neutral axis, and that the tendency of the rope to throw outwards would assist this. We suppose even Mr. Herbert will admit that if A be the extremity of a steel spring band, any weight, w, hung upon it will hang



somewhat as shown, and certainly not in a vertical line below *b*. The difference is entirely one of degree, and in case of a stiff rope may be about as much as the departure of the neutral axis from the centre of the rope. No one knows just how much either of the two may amount to, and the safest practice is certainly to assume that the neutral axis coincides with the median line.—Eds. Elec. Rev.]

Health Precautions in Accumulator Factories.

To anyone interested or engaged in the manufacture of accumulators, your recapitulation of the remarks of Dr. Schoop in your issue of September 6th must be of much value, for there are few occupations so insidiously dangerous as that of an accumulator workman, unless he is scrupulously cleanly himself and his employers equally strict in their enforcement of protective measures to maintain the health of their employés. While endorsing every word of the above-named gentleman, I should like to add a few facts and precautions which, if taken notice of, will, I am sure, be followed with beneficial results.

"The operation of pasting is better carried out in sheds open on one side, preferably the south."

"The beard and moustache should always be worn if possible."

"The custom of supplying men with milk is of great value."

"Soap powders are far more efficacious than any hard or soft form of soap, but prior to washing with water at all the hands should be well washed with petroleum."

"If boy labour is employed the boyish practice of eating fruit or sweetmeat whilst at work should be invariably repressed, although I find that adults are far more readily attacked than others."

"Moreover, I have noticed that men of fair complexion and light hair are affected in a greater percentage than darker men."

That a great deal depends upon the workman himself is beyond question, and dangerous as neglect may be one can easily understand the feeling which prompts a man, after a hard day's work, at the sound of the bell to get off home as quickly as possible. He is tired. Plumbism is so insidious. It is a cumulative poison which causes it, and it comes as a thief in the night. It has been my sad experience to witness more than one fatal case, and I have endeavoured as far as I have been able to combat this terrible bane which affects more or less the whole of the labour employed in any calling in which metallic lead or lead salts are largely used.

One thing above all is imperative, and that is, that if it becomes at any time necessary to call in a medical man, the sufferer should at once tell him his occupation and show him his teeth. I mention this because I have known young doctors treat men suffering from lead poisoning for totally different ailments, and this is a mistake which only experience prevents.

One of your largest advertisers, in whose firm I once held a position, exhibited the greatest kindness in cases of this kind and paid anyone, rendered for a time incapable of working, his full wages, and very feelingly remarked that "if a man was laid on a sick bed through the work he

employed him to do, it was only just to pay him until he was well again."

Men engaged in "forming" plates, whether Faure or Planté, I have never known attacked, although their teeth are affected by the acid spray.

A hot bath as often as possible should be taken and the daily administration of half a fluid dram of syrup of iodide of iron in water night and morning will prove of enormous advantage. The latter is not at all unpleasant and not very expensive when bought of wholesale drug vendors. With many thanks for your frequent courtesy.

F. E. Everard.

Electrical Communication between Lightships and the Shore.

Your leaderette in your August 30th issue, in criticism of my letter on "Coast Communication," which you did me the honour to publish in your journal of the 23rd ult., calls for a reply.

I will endeavour to be brief.

As to the trials with the non-continuous cable system between the Needles lighthouse and the Isle of Wight in 1893. I quite comprehend the reasons you quote for the selection of this locale for the purpose, but, if telephonic or telegraphic communication by this method was sufficiently successful, where was the necessity for replacing it by a continuous cable?

In the Electrical Review of August 25th, 1893, page 215, under head of "Coast Communication," it is reported that. . . "The lighthouse at the Needles will also probably be provided with *permanent* communication at an early date. The experimental connection by means of a non-continuous cable . . . will, it is thought, be abandoned . . . and a continuous cable laid down."

This, with what follows, would, I take it, be construed by an ordinary reader to mean the reverse of a success at that time. I do not in my letter question the success of the system at present.

Touching the question of slack cable lying on the bottom near to the copper mushroom off the Fastnet, I rather think there is an inaccuracy in your statement of the depth, which I understand to be 11 fathoms, not 15. As to this cable and its termination being out of danger of damage from seas, probably the coming winter may decide.

Apropos of the telephone being a *sine quâ non* for lightship communication, I would refer you to Sir J. N. Douglas's evidence before the Royal Commission of 1887—par. 119—122, also that of Mr. E. A. Stevenson—par. 3,251—3,258—on the trials at the "Sunk" lightship, with which communication was both telegraphic and telephonic, the telephone being preferred; in fact this popular instrument proved the most useful, and could be used when both Morse and A.B.C. were unworkable, *vide* Mr. Stevenson's evidence. This gentleman says (par. 3,251, concluding part): "With two receivers, one for each ear, all external sounds are shut out, and in the highest gale there is no difficulty in hearing." Again, in par. 3,258—Commissioner: "I think I understand you to say that the instrument you prefer, and best adapted to the work is the telephone? Yes; from the fact as I have before stated, that, on the ship not being able to speak by the two other instruments, the telephone actually did the work."

In the third report of the Royal Commission (April 26th, 1895) appointed in 1892, the Commissioners say: "This system, the continuous cable, permits of the free use of the telephone, which, in our opinion, is an important advantage."

Surely there can be no doubt of my meaning as to the use of the telephone, for my words are "The employment of the telephone as a *speaking* instrument in the case of lightships."

As to each man being supplied with a telephonic receiver, your meaning, to me, is not clear. If you mean each man on board, such a provision would not only "not be likely" but absurd.

In the *Electrical Engineer* of April 5th, 1885, you will find under "Telephonic Communication with Lightships," a reference to the means employed by Prof. Lucien J. Blake, to telephonically connect a lightship with the shore at Wood's Holl, Mass., by a method in which the telephone cable is fastened to the anchor chain. The telephone cable passed through the fluke of the lightship anchor, and communicated through the anchor chain with the vessel.

This worked well until the lightship dragged her anchor during a gale and snapped the cable.

H. Benest.

September 4th, 1895.

The "Milver" Battery.

We have read with interest the article in your current issue upon our battery, and must say that your contributor appears to believe in lynch law, *i.e.*, "execution first, trial afterwards."

We are unaware of the precise source from which your quotations are taken, but there are several inaccuracies therein which we must ask you to kindly correct. We did not state that "we had found a substitute for zinc at one-twentieth of the price," but that our substitute and our solution combined would produce electricity at one-twentieth of the price of the zinc battery. Neither did we state that "we did away entirely with polarisation," but that we reduced it to an absolute minimum.

We do not contend that our battery will compete in cost of production for lighting with large installations with engine and dynamo, but we do maintain that our battery is far more efficient and cheaper than any known secondary or primary battery for traction, and will also produce electricity quite as cheaply as it can be supplied by lighting companies, and in thousands of cases far more conveniently.

As regards the secret of construction of the Milver battery, about which you ask your readers for information, we shall shortly have a public demonstration of its uses, of which we will give you due notice, both for motor power and for lighting.

We shall then be glad to afford every opportunity of the fullest investigation to one of your qualified representatives, or any electrical expert who desires to go into the matter, and have no doubt of receiving an entirely satisfactory report.

Arthur Levetus, *Secretary,*
The Milver Portable Electric Battery Syndicate, Limited.

Birmingham, *September 9th*, 1895.

"Municipal Electricity."

As the article under the above head in your issue of 6th inst. might lead to some misapprehension, I beg that you will allow me to say that as a joint "undertaker" under the "Galway electric lighting order," I superintended the erection of most of the works for the first three years, but owing to want of agreement with Mr. James Perry I felt bound to withdraw from the management. The works have since then been in his hands, and he is entirely responsible for his own views, in many of which I need say I do not share, and also for all the work that has since been done.

J. E. Pearce, A.I.E.E.

Maidenhead, Berks.,
September 7th, 1895.

Electric Lighting of a Great City.

I find some difficulty in criticising the remarks made in your last issue concerning myself. Till now I have regarded the articles in your journal worthy of careful attention, but after reading the one referred to my faith has departed. The writer of the article in question may have great knowledge on some subjects, but he is utterly ignorant of the matter he wrote about. At least half the troubles at Bankside were due to the causes your writer says do not exist, and most elaborate enquiries were made to prove the matter. Your writer seems to know nothing of Ferranti's coil produced to get over the difficulties referred to. The core of this coil is like a compensated pendulum for temperature variations, and the copper ribbon is ribbed to prevent the layers shifting to and fro during the passage of the alternate current. I should

have thought that the experiments which I showed at the Royal Society with an alternate current passing through a lamp filament held in a steady magnetic field would have convinced the most uninstructed. These experiments were the outcome of others to show the shifting of the copper in the alternator coils of the ribbon type.

I will occupy no more of your valuable space, but leave station engineers to value remarks on practical matters in your periodical according to their intelligence.

David Salomons.

[We sympathise with Sir David Salomons in his difficulty of criticising our remarks, and we profoundly regret the departure of faith which he has suffered. Sir David is quite mistaken, however, in assuming that our criticism extends a single inch outside the line of his expressed opinions.

We know nothing whatever of the "troubles" or "experiments" at Bankside, for every man with a pencil and notebook is jealously excluded from that institution, but even without this particular knowledge, we are quite competent to discuss, and even criticise, opinions concerning the fundamental laws of electro-dynamics.

Sir David's exact words as reported, are as follows:—"The continual vibration due to the alternating current must not cause friction enough to wear away the insulation." To this statement we demurred, on the ground that the said vibration, assuming it to exist, is not due to the alternating current, and Sir David has now kindly provided us with an illustration, by quoting his experiments at the Royal Society, when a lamp filament placed in a *steady field* was subjected to the passage of an alternating current. The defect in the arrangement lay in using a steady field. The field ought to have alternated with the current as it does in a dynamo, whether alternating or continuous.

With regard to Ferranti's coil, Sir David unnecessarily exaggerates our ignorance, for we know the coil well, and have heard that the City Company are about to try a set in one of their machines. We also quite understand Mr. Ferranti's method of compensation for expansion, which he partially attains by making the radial support of his bobbin of metal, which will, on being heated, increase the diameter of his armature, and consequently the circumference—thus providing more space for the expanded copper.

But in the application of these coils to the Mordey machine at Bankside, the coils being supported at their outer ends, the effect of expansion will be to *reduce* the diameter of the armature and to provide less room for the expanded conductor, so the result will be the same as in a compensated pendulum with the bars transposed.

We respectfully commend this point to the notice of Sir David Salomons and his co-directors.

We can assure our distinguished correspondent that although our space is valuable, it is always his to command. —Eds. Elec. Rev.]

Some Exceptions to Ohm's Law.—It has been observed that amongst the liquids there are certain of low conductivity; for example, benzene, xylene, and turpentine, which do not seem to follow Ohm's law, but which, under the continued influence of a high electromotive force, show a gradual alteration in conductivity. These liquids also exhibit the phenomenon of electrical convection, a current of the electrolyte setting in from the one electrode, whilst the other appears simply to attract the repelled liquid. Recently, Emil Warburg has been investigating these phenomena. He employed mixtures of liquids which possessed low conductivity, gradually reducing the proportion of one of the constituents until the conductivity was nearly that of the other. Such mixed solutions as these were found still to exhibit the above phenomena. The behaviour of these solutions, in fact, was such that Warburg is led to the conclusion (*vide Ann. Phys. Chem.*, 1895 [2], liv., pp. 396—433), that they contain an electrolyte in a state of great dilution, upon which their conductivity depends. He suggests that the extraordinary behaviour of the so-called pure liquids is capable of a similar explanation.

BUSINESS NOTICES, &c.

Aluminium Alloys.—The Technical Association of London, Limited, is at present equipping a large laboratory, and has opened works and offices in London for operations in the manufacturing and refining of metals and alloys. The Association is exploiting processes for the production and electrical purification of aluminium and aluminium alloys. The Company has sent us a translation of an article, which is stated to have appeared in a French contemporary, on the electrical furnace and its recent applications. This article, after referring to the priority claims of Moissan and others, says that in the month of March, 1892 (nine months before Moissan made his first public communication on December 12th, 1892), Dr. Baxeres Torres, a distinguished but unobtrusive chemist and scientist, applied for a French patent (No. 220,519), and this was followed by three additions in April, and a fourth in May, 1892. These patents are stated to contain everything that can be done in the electrical furnace, preparation of metals, alloys, carbides, &c. Ever since Dr. Baxeres Torres took out the patents referred to he has continued working at the development of these processes, and this company is now established to work out practically, on commercial lines, his metallurgical processes and patents. They have sent us a table card of comparative standard weights of sheet aluminium. The offices are at 41, Parliament Street, S.W., and the works at 17, St. Anne's Court, Wardour Street, W.

Bankruptcy Proceedings.—Mr. Edwin Barron Lumb, of 85, Gracechurch Street, E.C., was, on September 2nd, appointed trustee in the bankruptcy of George Frederick Rogers, electrical engineer, of 41, Maxilla Gardens, Notting Hill, S.W., and 5, Great Winchester Street, E.C.

Business Announcement.—Mr. Wilson Hartnell, M.I.E.E., having removed his works into larger premises, situated in Kirkstall Road, Leeds, is now transferring his offices to the same address. Possessing great facilities for the production of all kinds of engineering work, Mr. Hartnell purposes extending the manufacture of dynamos, electric motors, together with switchboards and electrical appliances. He is also giving special attention to the transmission and distribution of power by means of electricity.

Fibre.—The Delaware Hard Fibre Company, of Wilmington, Del., whose London offices are at 15, Long Lane, E.C., recently doubled the size of the plant at Wilmington, but notwithstanding this the amount of orders in hand necessitate the operation of the works both day and night.

The "Weinert" Arc Lamps.—Messrs. Wilhelm & Co., of 132, Wool Exchange, Coleman Street, E.C., have been appointed sole agents for the United Kingdom for the arc lamps, &c., manufactured by K. Weinert, of Berlin. The differential arc lamp which is shown in fig. 1 is of simple and solid construction. A series or main coil, *b*, and a shunt coil, *c*, are placed upon a base. In each coil there is a solenoid, *m* and *n*, both of which are attached to the armature, the latter being perfectly sensitive. The armature, *e*, is pivoted upon an axle of tempered steel, the points of which are easily adjusted by means of two screws, *a*. The gear wheels revolve on steel spindles, their tension varied by means of screw, *d*, and are regulated by means of a brake, L, which is connected with the armature, *e*, by a connecting rod, *t*, with the result that the armature, *e*, is oscillated simultaneously. There is an atmospheric dashpot, I, attached to the side of the movement for the purpose of regulating in conjunction with the main and shunt coils the feed of the arc. There is a regulating screw underneath the base, which, by being screwed backwards and forwards, moves the lever, *f*, in such a manner as to bring into action at a right tension the spring, *g*, which, as it will be observed, acts as a check, or *vice versa*, in connection with the clockwork and magnetic coils. By means of this simple adjustment a 9-ampère lamp will run with 7 or 9 ampères of current and an ordinary rise or fall of potential. The upper, or positive carbon holder is properly equipoised and is suspended by means of a chain which runs over a chain wheel attached to the axle, the tension of which is varied by means of screw, *d*, and thence passes through a side tube, *y*, to the lower, or negative carbon holder, thus at all times keeping the lamp thoroughly focussed. By the overweight of the positive carbon holder, and by means of the chain, the movement is thrown into action until the carbons meet, when the movement is raised so as to form the arc, and the brake lever, *h*, is thrown into action. To act as a check against the movement there is also attached a fan to the brake wheel. There is on the base a standard, *s*, upon which the brake lever rests when it is necessary that the lamp should be feeding, and immediately the movement is raised the lever is lifted from the standard and acts as a check thereto. The current enters by terminal + and passes along a wire specially insulated to the positive carbon holder, which is thoroughly insulated from the frame by means of a specially prepared insulation, and thence through the positive carbon to the bottom, or negative carbon, and then to the frame, which is connected by wire, in order to get over the increased resistance which would otherwise occur. The current then passes from the wire last named into the main or series coil, *b*, and then to the negative pole. The shunt coil, *c*, has a very high resistance and there is, therefore, no possibility of heating. It will be readily seen from the construction of the lamp that immediately it is switched out the brake wheel is released and the two carbons meet, so that they are in a position to strike the arc when the lamp is thrown into circuit again, and that so soon as the coil, *b*, is energised the solenoid core, *m*, is

drawn down, thus raising the clockwork and throwing into circuit connecting rod, *t*, thereby raising the positive carbon and lowering the negative carbon to the necessary distance for the maintaining of the arc. The resistance of the arc is in proportion to the consumption of the carbons, with the result that the solenoid core in the shunt coil, *c*, is drawn down, and thus by means of the connecting rod, *t*, the clock-

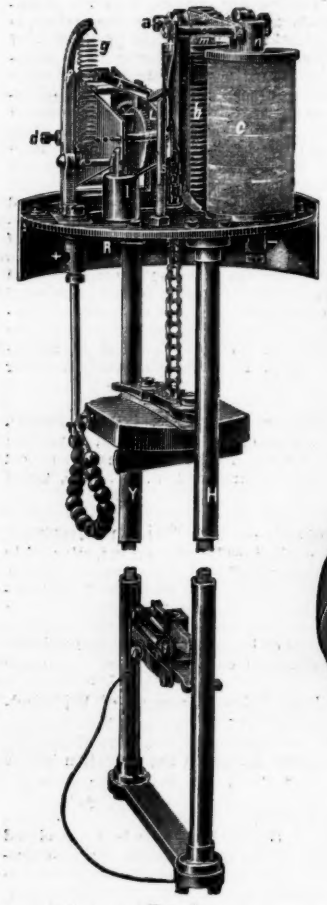


Fig. 1.

Fig. 2.

work is lowered to its lowest point, releasing the brake, *h*, and thus causing the lamp to feed as and when required. Fig. 2 shows an ornamental frame of brass, gold covered, for fitting to arc lamps. Various types of fittings, some of them very artistic, are shown in Catalogue No. 5.

Fire.—Mention having been made in the daily papers of the fire which occurred at the paint works of Messrs. Griffiths Bros. and Company last week, we are asked to notify that the business is being carried on as usual.

ELECTRIC LIGHTING NOTES.

Africa.—From the *British and South African Export Gazette* we cull the following items of interest *re* electric lighting matters in Africa:—

It has been proposed to lay down a system of electric lighting at Salisbury with arc lamps for street lighting, and 8 and 16 candle-power glow lamps for domestic purposes.

A 200-H.P. compound engine, by Messrs. Yates & Thom, will drive the new battery of 60 stamps, electric pumps, and dynamos at the new Comet mine. An auxiliary engine has been provided for the electric lighting plant.

Through Messrs. Reunert & Lenz, Johannesburg, Messrs. Mather and Platt, Limited, have supplied to the Henry Nourse mine four 42-unit Edison-Hopkinson dynamos of 60 H.P. each, for supplying light and driving the tailings wheel, two vertical and two centrifugal pumps, a lathe, and the tailings haulage plant. The same firm have also supplied to the mine three 30-H.P. Edison-Hopkinson motors for driving the pumping machinery, and another, also of 30 H.P, for working the machine tools in the workshops.

Messrs. Reunert & Lenz, Johannesburg, the agents for the Edison-Hopkinson dynamos and Edison-Swan lights, have orders in hand for electric lighting installations at the Wemmer, Robinson, Princess, Roodepoort Deep, Langlaagte Star, Village Main Reef, and Bonanza Gold mines.

Orders may be expected for electrical plant for the lighting of the Berea Barnato Park, Johannesburg.

Messrs. Lloyd & Lloyd, Birmingham and Johannesburg, have secured the order from the Johannesburg Sanitary Board for the iron poles to be erected in connection with the extension of the electric lighting system.

Alsager, near Stoke-on-Trent.—A meeting of ratepayers was held, on Friday last, to consider the advisability of adopting some system of street lighting. The circular issued by the District Council convening the meeting laid the cost of gas and electric lighting before the ratepayers, and showed that the former would cost £142 per annum, or an increase in the rates of 3½d. in the £. These figures were obtained from estimates provided by the Kidsgrove Gas Company, which has mains laid in Alsager for private supply. A scheme of electric lighting, prepared for the Council by Mr. G. R. Peers, A.I.E.E, placed the cost of an installation for 1,200 lamps of 8 C.P. alight at one time at £4,000, including 40 street lamps. The annual cost of maintenance would be £618, while the revenue expected from 1,500 lights fixed would be £700, leaving a profit of £82, or no increase in the rates. The Gas Company was well represented at the meeting, and during the week two circulars had been issued trying to show that electric lighting was a very risky venture. When the *pros* and *cons* of gas lighting had been exhausted, Mr. Peers was called upon to address the meeting, and was asked several questions relating to electric lighting, which he satisfactorily answered. The meeting was adjourned to "that day twelve month."

Arklow.—A deputation of the Arklow Town Commissioners interviewed Mr. A. Chamberlain in reference to the proposed electric lighting of the town. Mr. Chamberlain stated that the expense of arc lamps would be very heavy, and in his opinion would not be suitable for the town, owing to their small income. Of course the cordite works were at present lighted with electricity, but in order to supply the town with electricity it would be necessary to have extra plant and machinery. However, in the near future Messrs. Kynoch & Co. purposed lighting their chemical works with electricity, and when that was carried out his company would be disposed to meet the Commissioners in any way that they possibly could, as they would then be able to supply a current of electricity at a great deal cheaper rate.

Battersea.—The Special Electric Lighting Committee have resolved to invite competitive schemes for lighting the parish by electricity, and to offer premiums for the best three schemes submitted. In the meantime an application is to be made to the Board of Trade for a provisional order authorising the Vestry to supply electricity for public and private purposes. The compulsory area in which distributing mains are to be laid within two years includes all the principal streets in the parish.

Blackburn.—We learn that the Preston New Road district of Blackburn is to have the electric light. The high tension alternating system is proposed, and Mr. E. M. Lacey, A.M.I.C.E., has been consulted on the question of cost.

Canterbury.—The surveyor has, as instructed, obtained information from various districts where the electric light has been adopted, and laid it before the Electric Lighting Committee. The services of Mr. Robert Hammond are to be retained for the purpose of preparing a report and advising the Council upon the subject, at a fee not exceeding 50 guineas.

Cheadle.—A local firm (Messrs. J. and N. Phillips) has offered to light the town by electricity, at an annual cost of £340, for a 7 years' term, or £300 for a period extending over 14 years.

Chelsea.—The annual report of the Vestry's surveyor as usual has a section devoted to electric lighting, which gives the following information:—

"The number of houses in Chelsea lighted by electricity for the last three years was as follows:—

	1892-3.	1893-4.	1894-5.
Chelsea Electricity Supply Company	390	500	598
London Electric Supply Corporation	...	6	9 (?)

"The Chelsea Electricity Supply Company have made various applications to extend their mains throughout the area east of Beaufort Street, and are making steady progress with the lighting of the better class property in Chelsea. The London Electric Supply Corporation made an application to extend their mains through Cadogan Gardens, Draycott Place, Smith Street, Tedworth Square, Cheyne Walk, and the Embankment, and I recommended the Vestry to ask the Board of Trade to compel the company to establish converting stations if they carried out any large extensions, so as not to supply at high pressure. In January the Chelsea Electricity Supply Company made an offer to light certain streets by means of arc lights, but the Vestry were unable to accept the offer. I have examined the pressure records of the Chelsea Electricity Company from time to time, and find that they still maintain a very good average. A voltmeter connected to their mains has been fixed in my office, and it usually stands quite steady, slightly above 100 volts. When the London Electric Supply Corporation made application to extend their mains, I reported to the Vestry that the record kept at Adelphi Terrace was useless as a record of pressure in the Chelsea circuit. This led to some correspondence with the Board of Trade and the company, but the only result was to strengthen my conviction, and consequently I have not examined the company's pressure records since the matter was reported to the Board of Trade. Only one application was made during the year to have a meter tested, which was

from 46, Elm Park Gardens. Mr. Morgan Williams, A.M.I.C.E., tested it on behalf of the Vestry, and it was found to be registering 1·3 per cent. *under* at full load, to be correct at half load, and 15 per cent. *over* at a light load. As the load was very light at these premises, a smaller meter was inserted by the company, and the cost of the test was paid by them. Messrs. B. Verity & Sons wired and fitted up the Town Hall for electric lighting. Up to the present time the difference in cost as compared with gas is inappreciable."

Coolgardie.—The Westralia Company having acquired the concession for the exclusive right of furnishing electric light to the municipality of Coolgardie, W.A., for the term of 21 years has re-sold the concession to the Westralian Electric Lighting and Supply Company, Limited, formed for the purpose of acquiring the concession from this company. Its capital is £80,000 in £1 shares, of which £35,000 is working capital.

Dundee.—At the suggestion of Mr. Blackman, electrical engineer, experiments are to be made to ascertain whether the electric lighting would be improved by the suspension of overhead lights from wires lodged between standards from each side of certain thoroughfares. Two such lights are to be introduced into Broad Street, and other two into Bridge Street or Market Street.

Eastbourne.—The Electric Light Company are extending their mains in Terminus Road and South Street.

East Grinstead.—The District Council has decided not to bind itself in any way at present regarding electric lighting. Mr. W. Howard Tasker has offered his services as electrical engineer.

Earlston.—A committee, which was recently appointed to canvas the town with respect to the purchase of the Gas Works, have extended their inquiry as to whether it would not be advisable to introduce the electric light into Earlston. An electrical engineer conferred with the committee on the subject a few days ago. There is a proposal to form a local company to introduce the electric light.

France.—The question of the electric lighting of the quays at Bordeaux is under consideration. A central station is to be established in the little town of Mortain (Manebe). It is proposed to adopt electric lighting along the thoroughfares traversed by the tramways at Rouen. The electric lighting question is also under consideration at Albi (Tarn). A company has just been formed to establish and operate a central station at La Fleche (Sarthe).

Fort-William.—A meeting of the promoters of the Fort-William Electric Lighting Company was held last week. It was resolved to register the Company. The scheme of the Company is to light the town by electricity, the generating power being water, which is to be derived from the Kinchnish, a river about two miles from Fort-William. It is understood that the promoters have arranged with the Commissioners of Fort-William for the lighting of the town. The Company's share capital is £6,000, of which a substantial sum has already been taken up.

Glasgow.—Eight additional electric lamps were lighted in the city on 3rd inst. There are still five lamps to be erected west of the railway bridge in Argyll Street.

Halifax.—Public lighting experiments are to be made in Crown Street and Corn Market with arc lamps. If satisfactory, others will be erected at different parts of the town.

Hammersmith.—We understand that the Vestry intend offering £2,200 for land, situate in Fulham Palace Road, for a site for the electric lighting station. Fourteen tenders were sent in for the public and private installation, but the day following that on which all tenders should have been in, a firm telegraphed that their tender had just been dispatched. It was decided to open all the tenders when this one arrived. We hear that the City of London Electric Lighting Company has written a letter to the Vestry, in which, referring to a recent case in the Court of Appeal, it stated that it is intended to convene a meeting to determine upon a course of action with the object of obtaining an amendment of the law which will give reasonable protection to undertakers, and at the same time secure full compensation to all persons and bodies interested for all damage caused by the user of any electric light works.

Hanley.—The Council on 3rd inst. resolved :—"That the two assistant electrical engineers, Mr. Cowell and Mr. Sutherland, be appointed, pending the further installation, and during the expenditure of capital account thereon, joint electrical engineers and managers of the electricity works, under the direction of the borough engineer, at salaries of £150 each per annum, commencing on September 1st, 1895."

Hastings.—The Hastings and St. Leonards-on-Sea Electric Light Company has given notice of its intention to extend mains into various roads.

India.—An Indian exchange says that, from all accounts, there is a great demand for electric lighting in Colombo. The local firms of electrical engineers are said to have their hands full. Several private residences have had the installation of the light, and the new post office work is almost complete, the outside being fitted up with two electric light standards on the Prince Street side, and four on the Queen Street side, whilst Baillie Street has two bracket lamps. The solar arc and incandescent lamps have already been fixed within and without, and all that remains to be done is the connection with the engine and dynamo. Queen's House, which is also being fitted up, is on the verge of completion, and the Chartered Bank in Queen's Street will almost immediately be taken in hand. Our contemporary asks, "When is Calcutta going to begin in earnest?"

Kingston.—In reference to the paragraph published last week, Mr. J. E. Edgcome, the borough electrical engineer, writes us that our statement that "On and after January 1st, 1896, the Corporation has decided to charge only 4d. per unit for all current beyond a certain amount to large consumers," was incorrect. "As a matter of fact, the system we have decided to adopt is what is generally known as the 'Brighton system,' with the use of Wright's demand indicator. The new tariff will be as follows:—The present price of 6d. per Board of Trade unit will be charged until the customer has consumed sufficient electricity to average a daily use for two hours of the number of lamps he has had burning simultaneously, and all electricity consumed after that time will be charged at one-third less, viz., 4d. per unit. By this means all consumers, whether large or small, can benefit, as the rebate will be upon the number of hours a consumer uses his lamps, and not upon the gross amount of his account."

Lambeth.—At the last meeting the Vestry again considered the electric lighting question. A resolution was passed deciding to communicate with two electric lighting companies which thought of applying for a provisional order, informing them while they were not in possession of sufficient information to justify immediate proceedings under their provisional order, they had no intention of surrendering their order.

London, E.C.—St. Mary, Aldermary, is being fitted with the electric light, the work of installation being carried out by the Tayler-Smith Electric Company, Limited, of South Molton Street, W. Some of the ordinary gas fittings are to be retained. About 130 electric lights are being fitted, the nave containing 10 corunnas. There are about 50 lamps in the sanctuary and stalls, besides other lamps for the organ, vestry, font, &c. The installation is being carried out under the direction of the architect, Mr. C. Innes, 27, Queen Street.

The electric light posts throughout the City of London are now being re-coated with Hartmann's paint for iron and wood, which, we understand, has been selected for its durability and appearance after exhaustive trials extending over two years.

The Northampton Institute is being fitted for electric lighting by Messrs. Wenham & Waters.

Liverpool.—The City Council has decided to apply for a provisional order which will give them power to supply any and every district in Liverpool with electric lighting. This will in no way interfere with the purchase of the Liverpool Company's undertaking, but is an entirely separate affair.

Leeds.—Tenders have just been invited for lighting the St. Clement's new schools by electricity, but the estimates had to be in by Wednesday last.

Middlesbrough.—We hear that the Electric Lighting Committee of the Corporation have appointed Mr. R. Hammond consulting engineer.

Mevagissey.—Inquiries as to the cost of lighting by various methods have been made by several committees, and the figures collected show electricity the cheapest. The Council has therefore decided that:—"Provided an electric company be formed within a reasonable time, so as to admit of lighting the streets during the coming winter, this Council will offer such company the sum of £40 for lighting 30 lamps 1,500 hours in the ensuing twelve months. If any further lights be required it will be paid for at the same rate."

Middleton.—The Town Council has decided to apply for an order to authorise them to supply electric light within the borough. At first the compulsory area would be very small—comprising Long Street, Market Place, and Townley Street up to the Railway Station.

Rugeley.—Two tenders from electrical firms have been sent to the Lighting Committee, which compare very favourably with the cost of lighting by gas, and several electrical engineers have asked to be allowed to submit schemes. The Council is of opinion that it is too late to take the matter up this year, but it might be considered in 1896.

Ripon.—There was a general discussion on the lighting question at the last monthly meeting of the City Council, and councillors seemed to think the advantages possessed by electricity made it desirable they should have it for Ripon; but the question of cost was, of course, considered an important matter. The Gas Committee is to inquire fully into the matter. Messrs. Harrison & Co. have already installed public electric lamps at Ure Bank, across the River Ure, in the township of Sharrow.

Swansea.—The scheme for lighting the main streets by electricity, and using the plant for the purpose of destroying the town refuse, is now complete. The Corporation Committee has finally considered the report, which will be presented to the Corporation at its next meeting for consideration and adoption. The work, which is to be carried out under the guidance of Mr. Manville, will cost about £50,000.

Yeadon.—A meeting of ratepayers, to take into consideration the electric light question, is to be held under the auspices of the District Council.

Llanelly.—Schemes from the Electric Construction Company, Limited, Messrs. Siemens Bros. & Co., and Messrs. J. C. Howell, Limited, have been considered by a committee, which reported to the Council that £10,000 would be required to fix up an installation, and the Council has decided, on the question of expense, "that the work be not proceeded with."

Spain.—A small central station has just been completed and put in operation in the little town of Lodosa. It is proposed to establish a central station at Torrievieja, in Alicante province.

Tunbridge Wells.—The Mayoress (Lady Salomons) is to be asked to publicly open the electricity supply works. There will be an electrical exhibition in October. The Lighting Committee has appointed Mr. E. T. Stuart Menteath assistant electrical engineer.

Walsall.—According to a local paper, over 1,000 lamps have already been fitted, and the supply may be expected early in October.

Wandsworth.—The Board of Trade has appointed Major Cardew, R.E., to inquire into the matter of the appeal by the Electric Lighting Company, with respect to the disapproval by the Board of Works of certain plans of work proposed to be done by the Company under the Wandsworth Electric Lighting Order, 1892, and amended plans submitted by the said Company of the positions of the proposed street boxes.

Wells.—We understand the Town Council have retained the services of Dr. Hopkinson to advise them with regard to the electric lighting of the city at a stated fee.

Windermere.—The Parish Church officials are inviting subscriptions for the electric lighting of the church.

Wilmslow.—The District Council is to consider, at an adjourned meeting, whether it is worth while applying for an electric lighting provisional order.

Wolverhampton.—There is to be a Local Government inquiry regarding the Council's application to borrow £5,000 for electric lighting purposes.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Cape Town Electric Tramway.—The electric tramways construction is being pushed forward very rapidly on the Seapoint Road.

Electric Traction in Belgium.—The municipal authorities of Brussels have given their approval to the scheme for converting the Lacken-Anderlecht tramway into an electric line.

Electric Traction in Germany. — The Continental Company for electrical undertakings, of Nuremburg, is reported to be preparing plans for an elevated electric railway between Halle and Leipzig. An electric tramway is to be constructed between Meckenbeuren and Tettnang, in Wurtemburg. The contract for the line has been given to the Maschinenfabrik Oerlikon. The difficulties in connection with the electric tramways between Dusseldorf, Grafenberg and Rath have been overcome, and the line is to be opened for traffic during the present month. A contract has just been given by the municipal authorities of Elberfeld to the Union Electricitäts Gesellschaft, of Berlin, for the construction of an electric tramway between Elberfeld and Cronenberg. The line will be on the overhead conductor system. The municipal authorities of Cologne are reported to be contemplating the construction of two lines of electric tramways in the town.

Electric Traction in France.—A company has lately been formed at Rouen to construct and operate lines of electric tramway between Rouen and Quevilly, between Rouen and the Monumental Cemetery, between Rouen and Croisset, and between Rouen and the Ouest Cemetery. A new electric tramway has just been completed and put in operation between Raincy and Montfermeil, near Paris. The line is 5½ kilometres long, and is on the trolley system. The generating plant comprises two Babcock & Wilcox boilers, two 100-H.P. engines, and two 62-kilowatt dynamos. An electric tramway is also to be constructed between Enghien and Montmorency. It is proposed to adopt electric traction on all the horse tramways at Versailles. An electric tramway has just been completed and put in operation between Lyons, St. Fons, and Venissieux, while an electric line is to be constructed at Belleville (Rhône), connecting the railway station with the harbour.

Electric Traction in Switzerland.—Work is at present in hand on the construction of an electric tramway between Zurich and Oberstrass. The electrical part of the work is being carried out by the Oerlikon Maschinenfabrik. Another projected electric tramway in Zurich is a line between the Hotel Bellevue and the Gare d'Enge. Concessions have also lately been granted for the establishment and operation of electric tramways between Zurich and Oerlikon and between Zurich and Hardthum.

Electric Cranes in France.—Messrs. Revollier, Bietrix & Co., of St. Etienne, France, have just turned out from their works nine overhead electric travelling cranes. Five of the cranes are intended for the works of the Forges et Chantiers de la Mediterranée and four for the creusot works of Messrs. Schneider & Co.

Glasgow Tramways.—The Corporation has instructed the Tramways Committee to further consider the question of mechanical motors and report. Several members opposed the proposal, as the subject not long ago was gone into very closely.

North Staffordshire Tramways.—The Hanley Parish Council have affixed the common seal to an agreement between themselves and the North Staffordshire Tramways Company with respect to electric traction by means of overhead wires, and to the powers of purchase by the Corporation not being exercised for the term of 21 years.

Power Plant for South Africa.—According to the *British and South African Export Gazette* the following works are in hand for South Africa:—Messrs. Mather & Platt, Limited, Manchester, have supplied the four dynamos for providing light and for driving the pumps and the circulating service at the Robinson mine. They are coupled for running in pairs, and have a power of 120 volts, 620 ampères, at 625 revolutions.—We understand that electrical motors will be ordered for driving the pumps in the new cyanide plant at the Robinson mine.—For the George Goch mine an electric pumping plant, capable of raising 50,000 gallons per hour, is to be put down.—It is not decided whether the new system of transporting ore from the shafts at the George and May property should be by means of electrical haulage or by continuous wire ropes. If electrical power is obtained for this purpose it will also be used for pumping.—Among the work now being done on the Simmer and Jack property is the installation of a large central electric generating station.—Messrs. Johnson & Phillips, Charlton, have in hand the plans for another transmission scheme in the Barberton district. Water-power will be utilised, and the electricity will be delivered by diphase currents five miles from the station. The power developed at the station will be 120 horses, and the difference of potential at the generator will be 3,000 volts. The same firm have a good order for alternators in hand for the Capetown and Suburban Electric Lighting Syndicate, Limited.—Messrs. Fraser & Chalmers have built at their Chicago works a new King triple expansion 600-H.P. vertical mill engine, with the firm's Corliss valve gear, for the Robinson mine. It has four cylinders with a 42-inch stroke, and is fitted with both surface and jet condensers and atmospheric connection. It runs at 80 revolutions, and is coupled direct to the battery shaft, from which it drives the dynamos from a rope wheel on to a countershafting.—The Crown Reef Company are erecting, for the treatment of their slimes, a plant consisting of six iron leaching tanks, nine solution tanks, and Messrs. Siemens & Halske's electric precipitation apparatus.—The eight multitubular boilers, which Messrs. Siemens and Halske are putting down for the new electrical power transmission plant at Brakpan, will be fitted with "Leach" mechanical stokers. The consumption of inferior and small coal by these stokers will reduce the cost of fuel for the boilers to 1s. 9d. per ton.—Two more of the Button & Wyeth electric diamond separators have been ordered for the Wesselton mine.

The Giant's Causeway Tramway Fatality.—We hear that there is to be a Board of Trade inquiry into the fatal accident to a cyclist to which we referred in our leading colums last week.

The Douglas and Laxey Electric Tramways.—In an article on "A Light Railway Object Lesson" in the *Times*, by a writer who apparently knows a good deal about the railways on the Continent, is the following interesting paragraph regarding the Douglas and Laxey electrical line:—"There are two other lessons, not without interest for us, to be learnt from the Isle of Man. The first has also to do with passenger traffic; but this time not by steam locomotives, but by electric traction. From Douglas to Laxey, a distance of seven miles, there is an admirable service of electric trams every few minutes. The cars run up hill and down hill over gradients as steep as 1 in 24—say, roughly, the same ascent as that of St. James's Street—at an inclusive speed of about 12 miles an hour. For most part of the distance the line is laid on bought land; but in the immediate neighbourhood of Douglas, it runs for some length at the side of the highroad. Here the wisdom of our legislation would restrict it to eight miles an hour, but the Manx tramcar, filled with English tourists, bowls along merrily at about 20. Of course no one is injured, and the horses on the road look across the kerbstone at the electric cars, and are no more disturbed by them than they would be if they were looking over the hedge of the meadow in which they were grazing at a passing train. The power for the Laxey line is conveyed by an overhead conductor. When one of the London tramway companies attempted to introduce this method of traction a short time back, it was defeated by the opposition of the London County Council, headed by Mr. John Burns, M.P., who declared that overhead wires would vulgarise and disfigure the streets, forsooth, of Fulham and Hammersmith. In deference to this really ridiculous prejudice—for having seen the overhead trolley system at work, not only in the midst of beautiful scenery like that at Douglas Bay, but also in the principal streets of various European capitals, I can vouch for the fact that it does not vulgarise and disfigure any more than a row of lamp-posts—Londoners are accordingly deprived of the benefit of the most convenient, rapid, and economical method of street traction known, and compelled to rely for their means of locomotion on horses, which not only block and defile the streets, but are themselves worked to death in about an average of two years."

TELEGRAPH AND TELEPHONE NOTES.

A New Submarine Cable.—The repairing steamer, *Pouyer-Quertier*, is proceeding to Venezuela in order to lay a cable between La Guayra and Puerto Cabello, a distance of about 70 miles. The cable is to be taken from the supply she has on board. This section is the first of a series which will be laid during the next four years, by the Compagnie Française des Câbles Télégraphiques, along the coast of Venezuela, under concessions granted in April this year, by which the landing rights were obtained for a term of 50 years.

Australian Land Line Interrupted.—Our readers may remember the interruptions to the Australian telegraph traffic which occurred in December last, and also in January of this year. On these occasions it was announced in the Australian Press that the locality of the interruptions was on the Port Darwin-Adelaide land line, between Charlotte Waters and Alice Springs. The Roebuck Bay route—the only alternative—was not then available, as the land line to the north of Perth, Western Australia, was also on both occasions useless for the transit of international telegrams. From the Sydney *Morning Herald* of July 29th we extract the following reference to still another breakdown:—"Communication has been interrupted on the Port Darwin line between Alice Springs and Barrows Creek since about 7.30 p.m. on Sunday. The line was expected to be restored at daylight to-day." It will from this be observed that the breakdown occurred in the vicinity of Alice Springs as in the two previous occasions referred to above. In this case no information is given as to the condition of the alternative land line.

African Telegraphs.—The use of the old Imperial temporary telegraph line between Mangwe and Palapye, *via* Tati, upon which so many breakdowns occurred, has been discontinued, and all messages now go *via* Macloutsie, over the new Government line.

Glasgow Telephones.—The Corporation of Glasgow has decided to present to the new Postmaster-General the application for a municipal telephone exchange license, for which they applied to Mr. Arnold Morley in 1893.

Glasgow-London Telegraph Service.—The Glasgow Chamber of Commerce has authorised the Home Affairs Committee to petition the Postmaster-General regarding the time taken in telegraphing between Glasgow and London. Members provided themselves with batches of telegrams, which showed that the average time over the Post Office wires was 30 minutes, and the longest 65 minutes. It was stated that the Glasgow Royal Exchange was framing a similar petition.

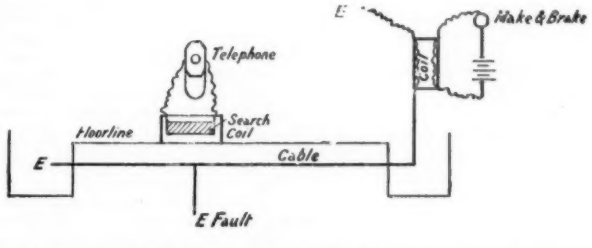
Telegraphic Communication in Turkey.—A telegraph line is about to be established between the fortifications at Adjé-Abad and the town of Gallipoli. A telegraph office is also to be established at Maidos, in the Dardanelles Straits.

Interruptions and Repairs to Cables and Landlines:—

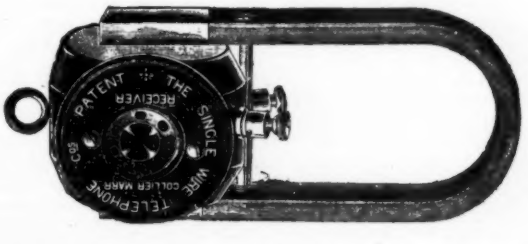
	Interrupted.	Repaired.
Cable: Brest-St. Pierre Anglo-American Company	6/4/93	...
„ Accra-Kotonon	12/8/95	19/8/95
„ Accra-Lagos	12/8/95	23/8/95
„ Aden-Zanzibar	2/9/95	...
Communication with Quito, Ecuador ...	20/7/95	9/9/95
Saigon-Bangkok landline	22/7/95	5/8/95
„ „ „	12/8/95	19/8/95
„ „ „	20/8/95	24/8/95
„ „ „	30/8/95	31/8/95
Siberian landline	25/7/95	25/7/95
„ „	28/7/95	28/7/95
„ „	9/9/95	...
Moulmein-Bangkok landline	8/8/95	10/8/95
„ „ „	15/8/95	16/8/95
„ „ „	20/8/95	20/8/95
Communication between Shanghai, Tientsin and Pekin	17/8/95	19/8/95

Mauritius and the Telegraph Rates to the East Coast of Africa.—On Wednesday, the 4th, Mr. Hanbury moved in the House of Commons:—"That the agreements (1) dated July 9th, 1895, between the Treasury, the Colonial Governments of the Cape of Good Hope and Natal, and the British South Africa Company respectively, and the Eastern and South African Telegraph Company; (2) dated July 10th, 1895, between the Treasury and the same telegraph company, providing for a reduction in the charges for telegrams between South Africa, certain places on the East Coast of Africa, Mauritius and Seychelles on the one hand, and Europe on the other, be approved." This motion was agreed to. The above *resumé* of the agreements referred to is literally correct, as far as it goes; but a perusal of the papers in question at once shows that it does not go quite far enough to be fully explanatory. In reading the agreements one is very much struck by the fact that, while these provide for a reduction in the charges for telegrams between South Africa and certain places on the East Coast of Africa on one hand, and Europe on the other, or which reduction is made in favour of the public, as well as of the Governments concerned—the British colonies of Mauritius and the Seychelles are dealt with in quite a different way. In the case of these colonies, the agreements provide for a reduction of rates for Government telegrams *only*. The charges for telegrams made to the public of Europe, and of these islands, remaining the same as it was before the agreements in question were signed. The position stands as follows:—Before the agreements which we are dealing with became effective, the charge per word from London to, say, Zanzibar, was, for the public, 7s. 9d.; it is now reduced to 5s. per word, in consideration of the extension of Government subsidies in favour of the Telegraph Company. In the case of Cape Colony also (to take another example), the former charge per word of 8s. 11d. has been reduced to 5s. Now, on the other hand, we find that, although an extension of subsidy has been granted by Government, partly in respect of the cable which unites Zanzibar with Mauritius and the Seychelles, the public rates to these colonies remain unreduced at the same figures as before the agreements came into force, viz., 8s. 9d. per word between the United Kingdom and Mauritius, and 7s. 3d. per word to the Seychelles. Thus, a through telegram arrives at Zanzibar for 5s., but if carried along the Mauritius cable from Zanzibar, as a through telegram it costs 3s. 9d. more. A telegram addressed to Zanzibar can be retransmitted to Mauritius at the local rate of 4s. per word. It is true that the extension in the subsidies at present paid to the Eastern and South African Telegraph Company by various Governments, has insured a reduction in the rates charged to the Governments concerned; but as far as the telegraphing public goes, it is to be regretted that the English colonies of Mauritius and the Seychelles should have been overlooked. We have at various times called attention to this possibility, and regret to find that our fears were only too well founded, and hope that, even at this late hour, and in view of the privileges granted by the agreements mentioned, amendment may be made. We cannot do better than repeat here what we have already written on this subject some months ago:—"That the Eastern and South African Company are well able to make such a concession is obvious, when we bear in mind that (according to the *Stock Exchange Year Book*) in nine years beginning in 1885, this company have paid in dividends to the shareholders the sum of £609,000 on a share capital of £600,000 (the *total* dividend paid on above capital since the registration in 1879 being, according to the above authority, £867,000). This statement does not include the amounts paid, and payable to, debenture holders, representing over £1,000,000."

The Improved "Collier" Telephone Receiver.—This instrument has now been before the public some time, but has not, in the opinion of those who know it best, received the attention it deserves. It is claimed to be the most sensitive, loudest, and clearest telephone receiver existing; and where, from any cause, the currents available to operate the receiver at the end of a telephone line are much reduced—as, for instance, by having passed over a very long line through a number of intermediate exchanges — this form of receiver has very great advantages, and will, it is said, in many cases



enable communication to be kept under conditions in which no other receiver will respond at all. The receiver is also well adapted for all ordinary work, since it can be had almost at the same price as most ordinary receivers, and even more cheaply than some; and the makers are, therefore, rather surprised that it has not up to the present been more widely used. The only thing that could formerly have been urged against it was the fact that its outward appearance was



perhaps, not taking. This has now been rectified, however, and the appearance has been considerably improved, as will be evident from the above illustration. The extreme sensitiveness of these instruments is said to be due to two causes:—1. The use of two diaphragms arranged in combination with a special shaped air chamber, so that each diaphragm reinforces the sound waves produced by the other. 2. The fact that the magnetic polarisation, owing to the special arrangement by which the lines of force are carried through an almost closed circuit of thick iron all the way, is exceptionally strong; and the coil being placed centrally on a short, well laminated core—not touching a mass of iron or steel at either end, but still well polarised—the power of the high frequency, but minute undulatory current, is exceptionally well conserved and reconverted into the form of energy

required, *i.e.*, sound waves. Altogether, therefore, it is claimed that this receiver stands at the head of instruments for long-distance work, and that it is the best receiver for all purposes. In conjunction with a Brown transmitter, also owned by the same company, surprising results are said to have been obtained. The diagram illustrates the use of the "Collier" receiver in the discovery of faults in street mains. Mr. Pocklington, of the Callender's Bitumen Company, Liverpool, has used it as shown for this purpose. He reports:—"In my opinion, your telephone receivers are by far the best I have yet tried for localising faults on underground mains. My experience extends over some seven years, and I have never been so certain of localisation with any other make." The search coil being moved along the ground, the non-intensity of the sound from the make-and-break indicates the position of the fault.

Telegraph Poles for Africa.—Iron poles have been used throughout in the new telegraph line between Mangwe and Kimberley. In view of the complaints as to the unsuitability of wooden poles, it is probable that iron poles will be used exclusively in the future for telegraph work in Africa.

The Reduction of Telegraph Rates to the East.—At a meeting of the Bristol Chamber of Commerce last week a letter was read from the London Chamber of Commerce respecting the cost of telegrams between this country, India, and the East, and the desirability of the existing tariffs being reduced. It was submitted that the lines could carry a much larger number of messages than they do at present, and that a reduction of the tariffs would assuredly be followed by a considerable increase in the traffic. Various other statements were made, after which Mr. T. T. Lindeat moved, Mr. J. Holman seconded, and it was resolved to co-operate in such measures as might be found desirable to secure an adequate reduction in the rates, and to bring forward the same at the International Telegraph Conference to be held next year.

CONTRACTS OPEN AND CLOSED.

OPEN.

Banstead and Colney Hatch.—September 30th. The Asylums Committee of the London County Council is inviting tenders for various works in connection with certain temporary iron structures which are to be erected for them. The list includes a fire alarm and telephone system, also heating arrangements at their asylums at Banstead and Colney Hatch. Particulars from R. W. Partridge, Clerk of the Asylums Committee, 21, Whitehall Place, S.W.

Belfast.—September 28th. Tenders are invited for the supply and erection of two direct-coupled steam engines and dynamos, battery of accumulators, main switchboard, and installation of about 232 incandescent lamps, complete, for the lighting of Belfast Lunatic Asylum, for the Commissioners for the Control. Particulars from Mr. O. A. H. M'Cowen, Chapel Lane, Belfast.

Braila.—October 2nd. The details regarding the tenders invited for electric tramways and lighting the city for the Municipal Authorities of Braila were given in our issue for August 30th.

Dundalk.—October 7th. The Town Commissioners invite tenders for an electric lighting installation.

Eccles.—September 18th. Tenders are wanted for boilers, engines, dynamos, cables, street boxes, and transformers for the Corporation lighting. Further particulars will be found among our advertisements.

France.—Tenders are at present being invited for the supply of four kilometres of paper-insulated double-conductor telephone cable. Tenders to be addressed to the Direction Générale des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Gravesend.—September 20th. Tenders are invited for supplying a telephone, and providing, delivering, and fixing, &c., the necessary poles, wires, instruments, &c., for a line from the sanatorium to the office of the sanitary inspector and the police station, for the town council. Particulars can be obtained of the sanitary inspector, Town Hall.

Germany.—September 21st. The construction of an electric local railway between Bonn and Königswinter or Honnef has been practically decided upon at the joint cost of the local authorities of Obercassel, Oberdollerndorf, Niederdollerndorf, Königswinter and Vilich. The last named body is inviting firms to submit plans, &c., for the projected line before the 21st inst. The firm whose project is accepted will be entrusted with the construction and working of the line. Projects and plans are to be sent to the Burgmeisterei, Vilich, Germany.

Harrogate.—The Corporation invite tenders for the supply and erection of plant, including boilers, alternators, switchboards, transformers, meters, and overhead travelling crane for electric lighting installation. Further details may be found in our advertisement supplement.

Huddersfield—September 16th. Tenders are invited for the lighting by electricity of the boot and shoe and confectionery departments, reading-room, library, &c., in John Street and Albion Street, Huddersfield, for the Huddersfield Industrial Society, Limited. Particulars from Mr. J. Barry, architect, 9, Queen Street, Huddersfield.

Harrogate.—September 30th. Tenders are invited by the Corporation for wiring the new Montpellier Baths for electric lighting. For further details see our advertisement supplement.

High Wycombe.—October 14th. The Chepping Wycombe Urban Sanitary authority invite tenders for working the electric lighting provisional order obtained by them within the borough, for a term of years and upon approved conditions. Tenders to be delivered to the Town Clerk, High Wycombe, from whom further details may be obtained.

London, E.C.—September 17th. Tenders are wanted for the following, for the Shoreditch Vestry:—(Section A) insulated electric mains; (B) conduits and drawing-in boxes, to be laid in the parish of Shoreditch. Specifications, &c., from Messrs. Kincaid, Waller & Manville, 29, Great George Street, Westminster.

Manchester.—September 20th. The Corporation invite tenders for the supply of about 15 tons of copper strip. Further particulars will be found in our advertisement pages.

Queenstown.—September 16th. Tenders are invited until Monday next for the public and private lighting of Queenstown by electricity according to the report and specification of Mr. Robert Hammond, M.I.E.E., Ormond House, London, for the Queenstown Town Commissioners. Tenders are also invited as follows: The contractor to provide the capital for the due erection of the works and maintenance thereof as per above plans and specifications, on being guaranteed the public lighting, and a stipulated number of private lights (to be agreed upon), the Commissioners having the right to purchase within a specified period. Further particulars and conditions to be had on application to Mr. James Ahern, town clerk, Queenstown.

Rangoon.—November 4th. The Municipal Committee is inviting tenders for electric lighting. Particulars to be obtained from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Roumania.—October 2nd. The municipal authorities of Braila, Roumania, are inviting tenders until October 2nd next for the concession for (*a*) lighting about 64 kilometres of public streets by both gas and electricity, and (*b*) 64 kilometres of public streets by electricity alone. They are also inviting tenders for the concession for the construction and operation of a network of electric tramways in the principal thoroughfares of the town. Tenders to the Maire, Hotel de Ville, Braila.

Spain.—The Municipal authorities of Jerez de los Caballeros (Badajoz province) are at present inviting tenders for the supply and erection of plant for the electric lighting of the town. Tenders to the Ayuntamiento de Jerez de los Caballeros (Badajoz).

Stafford.—September 14th. Estimates are wanted by to-morrow for wiring and fitting the infirmary for electric light, for the committee of the Staffordshire County Infirmary. Particulars from the engineers, Messrs. Kincaid, Waller & Manville, 29, Great George Street, London, S.W.

Sunderland.—September 13th. Tenders (to be lodged to-day) are wanted for (*a*) High-tension and low-tension concentric cables; (*b*) Cast-iron pipes, and box frames and covers; (*c*) stoneware casing, boxes, and bellmouth protectors; (*d*) high-tension transformers for alternating current; (*e*) Meters for alternating current for the corporation.

Vienna.—November 14th. The Municipality of Vienna asks for tenders and plans for the construction and working of electric railways in and around the city. The notice may be seen at the Commercial Department of the Foreign Office.

CLOSED.

Belfast.—The tender of Messrs. Coates & Son, for the supply of fuse boxes, has been accepted.

Hastings.—Four tenders were sent in for maintaining the electrical bell communication in connection with the Fire Brigade for three years. That of Mr. Frederick Bruce, at £30 per annum, was accepted.

Eastbourne.—The estimate of the Telephone Company for connecting an additional telephone line between the Police Station and the Destructor Works, and effecting certain alterations in other lines, for the sum of £210, has been accepted by the Council.

Taunton.—The Electric Lighting Committee has recommended that the tender of the British Thomson-Houston Company, Limited, to supply an alternator and a Willans engine for the sum of £1,058 be accepted.

A STEAM JACKET TEST.

The report of the National Boiler Insurance Company contains an account of a test made with a triple expansion engine, with a view to determine the effect of the jacket upon the H.P. cylinder and the first receiver only. The data of importance are a pair of 30 feet × 8 feet Lancashire boilers, at 158 lbs. pressure, a four-cylinder double tandem triple engine, indicating nearly 1,100 H.P., with a water consumption of 13·24 lbs. without, and 13·04 with jackets, showing a difference of only 1½ per cent. in favour

of the jackets, though this would have been more if some of the jacket drains had not leaked. As to this point, it is, at least, evidence that the jackets may have been emptied of air; but, generally, the evidence of the trial is worthless as to the value of jackets, for they only show about 0·1 lb. of water per H.P. hour collected, and can, therefore, only have furnished about 86 thermal units per lb. of steam used. If we assume a condensation of 20 per cent. of the initial steam from cylinder action, we should want at least 170 units per pound of steam to prevent this, and we only find half this quantity supplied by both jackets. But the cut-off in the H.P. cylinder was late—about ·425 of the stroke—and the condensation may have been but 13 per cent., in which case the jackets may not have acted amiss, and the result in such case is rather indicative of the comparatively small value of jackets in triple expansion engines, if these jackets can really be supposed to have been properly air-drained, which we doubt, and always shall doubt, without there is positive circulation. But the tests tell us something. They tell us that a 30 feet × 8 feet Lancashire boiler will provide steam for 550 I.H.P. to an engine using 13¼ lbs. of steam per H.P. hour, if provided with economiser. This amounts to 1·56 lbs. per H.P. hour, or 1,669 lbs. per hour. But on the second day's test the fireman was evidently on the *qui vive* all through the test, and put in practice what he had found to do well on the first day; the water evaporated was about 13 per cent. more per pound of fuel, or equal to about 1 ton of coal per day of 10 hours, thus showing that under a certain incentive the fireman could save fully 300 tons of coal annually, representing a money value of from £75 to £300, according to locality, a clear proof that some firemen would be cheap at £5 per week. Put into boiler duty, the 30 feet × 8 feet boiler would thus supply steam for quite 600 H.P., though burning less than 20 lbs. of coal per square foot of grate per hour, which is a very moderate rate of combustion.

The tests are chiefly valuable as showing how much a good fireman can improve upon his already fairly good record, for on the first day the evaporation was 10·1 lbs. from and at per pound of dry coal. The increased efficiency appears to have been entirely a matter of better air supply, the better results accompanying a smaller excess of air to the furnaces. Thus, by increasing the percentage of CO_2 present in the gases leaving the boiler by 20 per cent., the evaporation per pound of fuel goes up 13 per cent. The excess of air was reduced from 53½ per cent. to 44·9 per cent. This corresponds to a reduction from about 24·2 lbs. of air per lb. of coal to about 20·4 lbs. But 15 lbs. is possible, and even less air has been managed with under careful testing with thick fires and good draught, and if the reduction by about 4 lbs. signifies 300 tons of coal annually in a plant of 1,100 I.H.P., what might we not expect with only 25 per cent. excess of air? Probably another 300 tons per annum. This question of excess of air is most important, and forms one of the main roads to economy.

NOTES.

Battersea Polytechnic Institute.—The prospectus of the day and evening classes for the 1895-6 session has been issued. In the "Physics and Electrical Engineering" department there are classes on heat, light and sound, magnetism and electricity, electrotechnics, electric lighting and power transmission, alternating currents and their measurement, central station practice, electric wiring and house fitting, and electrical workshop practice. Copies of the prospectus can be obtained from principal Mr. Sidney H. Wells.

The B.A. President Indisposed. — As Sir Douglas Galton, the President of the British Association, was nearing the end of his inaugural address on Wednesday evening, a very painful incident occurred. Sir Douglas was noticed to be reading his address with considerable difficulty. In spite of kindly protests, he made repeated efforts to complete his task, but his strength and voice completely failed him, and after the Mayor, Lord Kelvin, and others had rendered him assistance, the remainder of his address was read hurriedly to an anxious audience by Sir John Evans. Later advices are to the effect that he has almost completely recovered.

American Electro-Therapeutic Association.—The programme of the fifth annual meeting of this Association, which has just been held in Toronto, is an interesting one. The list of committees' reports presented and the papers read show that American electro-therapeutists are very busy. The president, Dr. A. Lamphorn Smith, devoted his opening address to "Electro-Therapeutics in General Practice," after which the following reports of committees were presented:—

On Induction Coils and Alternators, Dr. A. H. Goelet, New York; On Meters, Dr. M. A. Cleaves, New York; On Static Machines and Condensers, Dr. W. J. Morton, New York; On Constant Current Generators and Controllers, Dr. W. J. Herdman, Ann Arbour, Mich.; On Electrodes, Dr. C. R. Dickson, Toronto, Canada; On Electric Light Apparatus for Diagnosis and Therapy, Dr. J. H. Kellog, Battle Creek, Mich.

Papers were read as follows:—

Further Studies of the Physiological Effects of the Sinusoidal Current and a Description of a Perfected Apparatus for producing both a Sinusoidal and a Direct or Galvanic Current, Dr. J. H. Kellog, Battle Creek, Mich.; The General Therapeutic Effect of the Alternative Current of High Frequency and of High Tension, Dr. G. Apostoli, Paris, France; Alternating Dynamo Currents in Therapeutics, Dr. W. J. Herdman, Ann Arbour, Mich.; Cataphoresis: Non-Conducting Drugs, fluids may be diffused by employing Conducting Electrodes in solution, Dr. W. J. Morton; Farther Successes in the Treatment of Neuralgias by Cocain Cataphoresis, Dr. Frederick Petersen, New York; Some Comments upon Cataphoresis in Throat and Dental Diseases, with the Exhibition of an improved Galvanic Current Adapter, Dr. W. C. Phillips, New York; Zinc Amalgam Cataphoresis, Dr. G. Betton Massey, Philadelphia, Pa.; Electricity in the Treatment of Heart Affections, Dr. W. F. Robinson, Albany, N.Y.; Report on the Electrolysis of Cystic Goitres, Dr. C. R. Dickson, Toronto, Canada; Gautier's Method of Electrolysis in Urethral Stricture, Dr. Robert Newman, New York; Electro-Therapy as a Means of Diagnosis in Gynaecology, Dr. Georges Apostoli, Paris, France; The Advantages of Electrical over Surgical Treatment, Dr. F. H. Wallace, Boston, Mass.; Discussion, Gynaecology, Dr. A. H. Goelet; Genito-Urinary, Dr. R. Newman; Faradism in Obstetrics, Dr. R. J. Nunn, Savannah, Ga.; Ovaritis, and its Treatment by Electricity, Dr. C. G. Cannaday, Roanoke, Va.; The Apostoli Treatment of Uterine Fibromata, Dr. E. R. Corson, B.S., Savannah, Ga.; The Physiological Action of Periodic Induced Currents in Gynaecology, Dr. A. H. Goelet, New York; Notes on the Use of the Continuous Current in Arthritis Deformens, Dr. H. S. Jewett, Dayton, Ohio; The Value of the Sinusoidal Current as an Adjunct in the Treatment of the Acute Insanities, Dr. Robert Stafford Newton, New York; Some Experiments with Static Electricity in Functional Diseases of the Nervous System, Dr. Francis B. Bishop, Washington, D.C.; Current Controller for the Static Induced Current—A New Rheostat, Dr. W. J. Morton, New York; An Interrupted rather than a Continuous Douche in Franklinisation—A new Form of Administration, Dr. W. J. Morton, New York; Hydro-Galvanism of the Urethra, Dr. Robert Newman, New York; Division of the Faradic Current to secure Intermitting Physiological Tetanus—A new Clockwork Apparatus, Dr. W. J. Morton, New York; New Transformer to Combine the Galvanic and Faradic Currents in a single Treatment, Dr. W. J. Morton, New York; Electricity Considered in its Relation to Surgical Gynaecology, Dr. O. S. Phelps, New York. Also a paper by Dr. Daniel B. D. Beaver, Reading, Pa.

Electric Elevators.—*Cassier's Magazine* for August contains an interesting article by Joseph Sachs, on "Electric Elevators." As it is illustrated by no less than 22 well-executed cuts and diagrams, it gives an up-to-date picture of the electric elevator as made in America, and is well worth study by engineers in this country. Practical work has reduced these to two types—the drum-winding machine, driven by worm gear from a motor, which is controlled from the cage, and screw-bar machines, which may best be described as a machine with a revolving bar and nut, taking the place of the "jigger" ram of the rope lifting hydraulic elevator, and acting by multiple sheaves to give a travel to the lift lower than the travel of the nut. The methods of control are various, but in almost every case the method is as follows:—A shunt-wound motor with series starting coil, some device to keep resistance in the armature circuit till the lift is well under weigh, independently of the car control, a brake to stop the motor the moment the current is cut off, and safety devices to cut off the current and brake the motor when the car reaches either extreme of its travel. The electric elevator appears to be rapidly replacing the hydraulic or steam elevator in America, on the ground of economy in work and cleanliness. In this country there are signs of the same thing. Messrs. Easton, Anderson and Goolden, Limited, have erected several electric passenger lifts embodying all the points described. Up to now, however, no one seems to have satisfactorily solved the problem of alternate current lifts; and this delays matters in parts of London where there would otherwise be a demand.

Climbing Down.—The climb down of our yellow contemporary yesterday, on the brake strap controversy, is pitiable; it is more than pitiable, it is downright dishonest. *Lightning's* criticism was directed to Mr. Herbert's first letter, which it stated to be unanswerable. Mr. Herbert admitted that he had fallen into error, and now our shifty contemporary tries to explain away its incapacity by falsely declaring that its nonsensical comments were directed to something entirely different. Only so recently as last week, the writer of the drivel which passes muster as the *Review of Reviews*, said :—"Mr. Herbert has put us in an awkward position : the position of an advocate whose client withdraws his plea of not guilty immediately after the speech which should secure his acquittal." Why did not the *Lightning* scribe frankly admit the mistake into which he had fallen? Perhaps, however, it is too much to expect manliness from such a source! We did not twit our contemporary for its misprint, but we may casually remark, *apropos* of its current issue, that Sumpner is not spelt with a *t*.

Safer than Lightning Rods.—"Each day," says Pearson's young man, "adds some new virtues to the long list of those already credited to the pneumatic tyre. The latest of these is that the wheels of a bicycle being encircled by a band of India-rubber and dry air—which is a perfect insulator—the rider is completely insulated from the earth, and consequently is impervious to the attacks of the electric fluid." Cannot Pearson's young man understand that a band of India-rubber made wet by riding through puddles, or during the rain which generally accompanies a thunderstorm, does not insulate the rider of a bicycle from earth? But probably surface leakage is unknown to the extraordinary beings who write technical (!) matter for Pearson's! In fact, any surface leakage over the tyres would put the rider direct to earth.

"Hyde Park at Night."—The arc lamp has sometimes been accused of luring butterflies and insects of various species within its fascinating influence, and then accomplishing their ruin. But it has continued to flicker laughingly, in spite of the existence of a Logrolling Company of Chanticleers, and that company now views the arc light as its friend, and is contemplating using it for enlightening some of the dark places of the earth. The same method of lighting is suggested by a *Times* correspondent for illuminating Hyde Park by night. He considers this would be a sure remedy for the prevention of the nightly congregation there of a certain unmentionable class of beings who, he says, "love darkness because their deeds are evil." This is not the only reason, powerful as it is, calling for the lighting of that magnificent park by electricity.

Our Trade with the East.—The recommendations contained in our article a few weeks ago regarding representation in China and Japan, are further emphasised by some comments which have just appeared in the *British Trade Journal*, from the pen of Mr. Anjow, of the Ashio copper mines at Shimotsuke, in Japan. He says :—

> The machine-building industry of Japan is as yet in its infancy; and although we construct some machines, there are others which we are obliged to import from foreign countries. . . . . American engineering firms are always looking for a demand for their productions here, and send us their catalogues, from which we can select at our convenience. They also send experts, who travel through the country and consult our mining engineers as to the machinery required. On the other hand, English manufacturers and engineers have only a few agents throughout Japan, and these do not generally push the sale of the machinery. In short, British engineering knowledge, and the trade policy of England in the Orient, does not tend to develop, while the Americans are making progress.

To a Correspondent.—If "T. R. K." will disclose his name we will publish the letter he has sent us, along with our reply thereto.

CITY NOTES.

Electric Construction Company, Limited.

At the second annual meeting held yesterday afternoon, at Winchester House, E.C., Sir Daniel Cooper, who presided, said: The report and accounts, if not so satisfactory as could wish, show a considerable improvement as compared with those submitted last year, and they give good promise for the future, for the manufacturing profit this year amounts to £31,814 12s. 7d., against £25,754 10s. 5d. last year. The profit has all been fairly and hardly earned, and might properly be applied in payment of a dividend on the ordinary shares, but the available capital is barely adequate for the development of the business, and at the same time to do justice to the debentures and shares in other companies inherited as a legacy from the old corporation. This is the sole reason that moved the directors to the conclusion that it would be for the advantage of the company and ultimately in the interest of the shareholders to make no distribution of dividend at present. Shareholders should have a little further patience. Dealing with the profit and loss account, they had reduced the working expenses fully £2,000. Further reduction might be made, but with due regard to efficiency, any further reduction can hardly be important. Besides maintaining and renewing plant and buildings, the depreciation account has been credited with £5,000 out of revenue, as compared with £3,000 last year. Some shareholders might think they had been rather too free in taking so large a sum out of the revenue of the year; but they preferred to err on the safe side. £5,000 was not fixed as the amount to be appropriated to depreciation every year. Turning to the credit side of the account, the gross manufacturing profit amounts to £31,814 12s. 7d., over £6,000 more than last year, which was very gratifying. Such profits in the circumstances evidenced the remunerative character of the business. On the assets side of the balance-sheet, £1,940 2s. 6d. has been added to the property account for additions to plant and buildings during the year. This sum has not been expended in replacing worn out tools, but for actual additions to plant and buildings which will enable us to turn out more work, and is thus an expenditure properly chargeable to capital. The old property of the company in Commercial Road, Wolverhampton, has been sold. The price obtained for the company (£2,500) has been handed over to the trustees of the first mortgage debentures, and has been invested by them for the benefit of the debenture-holders. There is little change on the account of investments in other companies, which consisted of various securities taken over from the old corporation. No interest has been charged to this account. Some small securities have been sold, and a considerable amount of new added, chiefly the result of obligations of the old corporation, and the total debit remains practically the same as last year. This asset, on the whole, had improved in value, and he believed that as the various undertakings develop, the amount at debit of the account will be fully realised. Amongst the more important works in hand are the large lighting installation at Clerkenwell, expected to be completed within the next two or three months, and the electrical equipment of the Hartlepool tramways, which we hope to have in operation about the beginning of next year. He believed there was a great future for electric traction, and if so, those who succeeded in solving the initial difficulties in the practical application of the new power might be expected to have the lead in the business. He was very confident that the electrical equipment of the Hartlepool tramways on the plans designed by Mr. Blackburn, will prove successful, not only from an engineering point of view but also in an economic and financial aspect, and lead the way to an important extension of business in this direction. They were full of orders for the next six months. The directors were now intimating a moderate advance in prices, such as is fully justified by the advance in materials and the improved prospects of trade. Sir Daniel concluded by saying, "For myself, speaking as one largely interested in the company, I have now more confidence in its management and in the profitable character of its business when prudently and carefully conducted than at any previous period of its existence."

Questions *re* Hartlepool Tramways and the company's litigation having been answered, the report was unanimously adopted.

Babcock & Wilcox, Limited.

The fourth ordinary general meeting was held on Tuesday at the offices, 147, Queen Victoria Street, E.C., Mr. Andrew Steward presiding.

The Chairman congratulated the shareholders upon the report, which was very satisfactory and gratifying. They had paid 12½ per cent. on the ordinary shares for the year, amounting to £23,500; £10,000 had been placed to reserve, and a balance of £4,830 17s. carried forward. Their patent boiler was finding new fields and markets, and the old fields were yielding more orders. Many improvements had been made in the boiler since it became the company's property.

After a short discussion the report was adopted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending September 8th, 1895, amounted to £839; week ending September 9th, 1894, £840; decrease, £1; total receipts for half-year, 1895, £8,509; corresponding period, 1894, £8,576; decrease, £67.

The Great Northern Telegraph Company. The traffic receipts in August, 1895, were £28,000; January 1st to August 31st, 1895, £202,800; corresponding months, 1894, £182,200; corresponding months, 1893, £180,000.

The Liverpool Overhead Railway Company. The receipts of this railway for the week ending September 8th, 1895, amounted to £1,342; corresponding week last year, £1,054; increase, £270.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 6th, 1895, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,026.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation Sept. 4th.	Closing Quotation, Sep. 11th.	Business done during week ended Sept. 11th, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb	100	...	4 %	4 %	102 —105	102 —105	...	...
1,912,880£	Anglo-American Teleg., Ltd. ...	Stock	£2 15s.	£2 11s.	£2 2s.	48 — 50	48 — 50	48	...
2,993,560£	Do. do. 6 % Pref. ...	Stock	£5 10s.	£5 2s.	£4 4s.	89 — 90	89 — 90	90	89¼
2,993,560£	Do. do. Defd. ...	Stock	...	...	...	8¾ — 9¼	8½ — 9	8⅝	8⅝
130,000	Brazilian Submarine Teleg., Ltd. ...	10	6½% §	6½% §	...	13¾ — 14¼	13¾ — 14¼	14¼	13¾
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000 ...	5	10%‖ §	... §	2½%	3 — 3⅛xd	3 — 3½	...	...
10,000,000$	Commercial Cable Co. ...	$100	7 %	7 %	7 %	160 —165	160 —165	...	...
224,850	Consolidated Telep. Const. and Main., Ltd	10/-	2 % §	2 % §	1½%	1/16 — 3/16	1/16 — 3/16	...	...
16,000	Cuba Teleg., Ltd. ...	10	8 %	8 %	8 %	13 — 14 xd	13 — 14	...	...
6,000	Do. 10 % Pref. ...	10	10 %	10 %	10 %	20 — 21 xd	20 — 21	20⅞	20½
12,931	Direct Spanish Teleg., Ltd. ...	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref. ...	5	10 %	10 %	10 %	9¾ — 10¼	9¾ — 10¼	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	...	...	4½%	103 —106	103 —106 %	...	...
60,710	Direct United States Cable, Ltd. ...	20	3½% §	2⅝% §	2 %	9 — 9½xd	9 — 9½	9½	9
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½%	17⅛ — 17⅜	17⅛ — 17⅜	17⅜	17⅛
70,000	Do. 6 % Cum. Pref. ...	10	6 % §	6 % §	6 %	17¾ — 18½	18 — 18½	18 1/16	...
102,100£	Do. 5 % Debs., repay. August, 1899 ...	100	5 %	5 %	5 %	105 —108	106 —109	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red. ...	Stock	4 %	4 %	4 %	127 —130	129 —132	130	128¾
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½ — 18	17½ — 18	18	17½
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	102 —106	102 —106	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	103 —106	103 —106	...	...
320,000£	Do. 4 % Deb. Stock ...	Stock	4 %	4 %	4 %	126 —129 xd	127 —130	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	102 —106	102 —106	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	103 —106	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	105 —108	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	113 —116	113 —116	...	...
180,227	Globe Telegraph and Trust, Ltd. ...	10	4⅞% §	4⅝% §	4½%	10½ — 10⅝	10½ — 10½	10⅝	10½
180,042	Do. do. 6 % Pref. ...	10	6 % §	6 % §	6 %	16¾ — 17½	16¾ — 17⅝	17⅛	16 15/16
150,000	Great Northern Teleg. Company of Copenhagen ...	10	8⅜% §	8⅜% §	8⅜%	21⅜ — 22¼	21⅜ — 22¼	22	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106 xd	103 —106	...	...
17,000	Indo-European Teleg., Ltd. ...	25	10 %	10 %	10 %	50 — 53	50 — 53	52	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs. ...	100	6 %	6 %	6 %	104 —108	104 —108	.	...
484,597	National Teleph., Ltd., 1 to 484,597 ...	5	5 % §	5 % §	5 %	6 — 6¼	6⅛ — 6⅜	6¼	6 1/16
15,000	Do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6⅞%	16 — 18	16 — 18	...	...
15,000	Do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	15 — 16	15 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6¼	6⅛ — 6⅜	6 5/16	...
1,100,000£	Do. 3½ % Deb. Stock Red. ...	Stock	3½%	3½%	3½%	106 —108	106 —108	107½	107
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4¼%	9/16 — 11/16	9/16 — 11/16	9/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	108 —111	109¾	...
11,839	Reuter's Ltd. ...	8	5 %	0 %	*nil*	3½ — 4½	3½ — 4½	...	...
3,381	Submarine Cables Trust ...	Cert.	...	...	...	127 —132	127 —132	130	...
58,000	United River Plate Teleph., Ltd. ...	5	...	...	...	2¾ — 3¼	2¾ — 3¼	...	...
146,733£	Do. do. 5 % Debs. ...	Stock	5 %	5 %	5 %	92 — 97	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109 ...	10	...	...	*nil*	5½ — 6½	5½ — 6½	...	...
238,300£	Do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	103 —106	104 —107	103½	...
30,000	West Coast of America Teleg., Ltd. ...	10	...	...	...	1 — 2	1 — 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	99 —104	99 —104	102	...
64,248	Western and Brazilian Teleg., Ltd. ...	15	2½%	2½%	3 %	10¼ — 10⅜	10 — 10⅛	10 7/16	10¼
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½ — 7	6½ — 7	...	...
33,129	Do. do. do. Def. Ord. ...	7½	...	...	1 %	4¼ — 4⅜	4 — 4⅛	4 5/16	4⅛
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	101 —105	102 —106	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	101 —105	102 —106	...	...
88,321	West India and Panama Teleg., Ltd. ...	10	⅛%	7/16%	¼%	⅜ — 1	⅜ — 1	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 10½	10⅛ — 10⅜	10½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½ — 9½	8½ — 9½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	110 —113	110 —113	112⅜	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	113 —118	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —103xd	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply ...	5	5 %	4½%	4½%	5¼ — 5⅜	5¼ — 5⅜	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	...	...	...	6⅞ — 7¼	6⅞ — 7¼	7⅛	7
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	116 —118	116—119	117½	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	15 — 15½	15 — 15½	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½ — 16½	15½ — 16½	16⅛	15⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	132 —135	133 —137	135	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8½ — 9½	8½ — 9½	9	...
10,000	Do. do. do. 6% Pref., £4 pd., 40,001—50,000	10	...	...	...	6⅞ — 7¼	6⅞ — 7¼	...	...
50,000	†Liverpool Electric Supply, all paid ...	5	5 %	5 %	5½%	7⅝ — 8⅛	7⅝ — 8⅛	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2 %	2½%	3 %	12 — 12½	12½ — 13	12½	12¼
150,000£	Do. 4½% first mortgage debenture stock ...	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd. ...	10	...	...	1 %	8½ — 9½	8½ — 9	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6½%	8¼ — 8⅜	8¼ — 8⅜	8⅜	8 5/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9½	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	8½ — 9	8¾ — 9¼	8 13/16	8 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Sept. 4th.	Closing Quotation, Sept. 11th.	Business done during week ended Sept. 11th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 % §	6 % §	...	1⅞— 2⅛	1⅝— 1⅞	1⅞	1⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	1⅞— 2⅛	1⅞— 2⅛	2⅛	1⅞
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
630,000*l*	City and South London Railway	Stock	⅝%	⅝%	1¼%	38 — 40	38 — 40	...	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	1 — 2	1 — 2	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	2 — 2⅛xd	2 — 2⅛xd	...	...
100,000	Do. do. do. 4½% Deb. Stock Red....	Stock	...	...	4½%	104 —107	104 —107	107	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	*nil*	⅝— ¾	½— ¾	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2 — 2⅛	2¼— 2⅜	2⅜	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	¾ — 1	¾— 1	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅞ — 1⅛	⅞— 1⅛	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	¼— ¾	¼— ¾	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	6½— 7½	6½— 7½	...	..
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	11½— 11⅝	11⅝— 12¼	12⅜	12¼
3,000	Do. do. do. 7% Pref.	10	...	...	...	15 — 15½	15 — 16	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	...	104 —107 xd	104 —107	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	19 — 21	19 — 21	20½	...
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	11 —11½	11½— 11⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15 — 15½	15 — 15½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	43 — 45	43 — 45	44	43⅜
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4½— 4¾	4½— 4¾	4¾	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.
Electric Construction Corporation, 6 % Debentures, 95—100.
House-to-House Company (£5 paid), 4—4¼.
Do. do. 7 % Preference, of £5, 8—8½.
Do. do. 4½% Debentures of £100, 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8—8½; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.
Liverpool Electric Supply, £5 (fully paid), 7¾—8¼.
London Electric Supply Corporation, £5 Ordinary, ⅜—½.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6¾—7.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

THE INSTITUTION OF JUNIOR ENGINEERS.

Belgian Summer Meeting.

Although brought into existence but a few years ago, this advancing Institution, now numbering over 400 members, has this summer held its first meeting abroad. The programme arranged proved so inviting as to attract the largest attendance yet recorded on such an occasion. The Council was represented by Mr. H. J. Young, Chairman; Mr. R. W. Newman, Vice-chairman; Mr. P. J. Waldram, Past-chairman; Mr. H. B. Vorley, Librarian; Messrs. H. Christ, W. B. Clarke, W. H. De Ritter, and P. Marshall, Members of Council; and Mr. Walter T. Dunn, Secretary. Special arrangements had been made with the Great Eastern Railway Company for the conveyance of the party throughout the week of the meeting, and as the Institution itself negotiated for all hotel accommodation, the members must have been spared a good deal of trouble incidental to such matters. Insignificant as they may appear in mentioning, these provisions doubtless greatly conduced to the enjoyment of the excursion.

Contrary to the practice of the older societies, no papers are read at the summer meetings of the Junior Engineers, the whole time being devoted to visits to works, and we think that the Council is well advised in arranging to take the greatest possible advantage of the opportunity for works' inspection. Papers can be read and discussed when the society is in session during the winter and spring months.

Harwich was the embarking rendezvous. From there the members, coming from all parts of the kingdom, crossed to Antwerp, arriving Saturday morning, August 17th. M. Gustave Royers, Engineer-in-chief to the Municipality, received the party, and expressed the pleasure he felt in being the first to welcome them in Belgium. Under his direction a tour of the docks was then made. The quay wall along the river extends a distance of 2¼ miles, and was constructed by movable cofferdams on the compressed air system at a cost of about £120 per foot run. The material used is Boom bricks, faced with Soignies stone. So prosperous is the port that it is intended very soon to prolong the quays another mile and a-quarter up the river. The docks, of which there are eleven altogether, in addition to six dry docks, are well equipped with hydraulic machinery for loading and discharging cargoes, the pressure being 700 lbs. per square inch. Two pumping stations are provided, one at either end of the docks; the southern station containing two engines, each of 250 H.P., and two accumulators, each of 120 tons weight. At the northern station are three engines, each of 150 H.P., and two 120-ton accumulators. For the railway depôts and bond stores some fine buildings have been erected, and, adjoining them is a locomotive repairing shop, which we noticed was lit by Siemens arc lamps. Antwerp, of course, owes its present position to the passing of the Treaty of the Hague, just 100 years ago. For a long time previously the town had been rapidly declining, but by the terms of the treaty the river Scheldt, being in 1795 thrown open to the navigation of the world, it was soon evident that Antwerp was destined to become of great importance. It has developed to such an extent that last year no less than 5,148 vessels, having an aggregate tonnage of 5,100,767, were berthed. By a happy coincidence the centenary of the freedom of the river was being celebrated during the Institution's visit, culminating on the Sunday in several most impressive religious and commercial processions through the town.

On the Saturday afternoon the Musée Plantin-Moretus was visited, by special arrangement with the authorities, the venerable director, M. Emm. Rosseels, showing the party over. The museum contains a collection of old printing

apparatus, woodcuts, engraved plates, and books, all of very great interest, and from their unique character, of inestimable value. The building itself is the actual house occupied by Plantin as residence and workshops, and is rich in carved oak and other work of the 16th century. In the evening the pumping station of the Compagnie Hydro-Electrique Anversoise was inspected.

On Monday the members proceeded from Antwerp to Ghent, where M. C. Carels met them. The first place visited here was the well-known works of Carels Brothers, noted chiefly for the production of steam engines of the Sulzer type. Although established more than 50 years ago, the value of modern improvements in respect to machine tools and other appliances have received full recognition by the firm, as exemplified by the *materiel* seen in operation. The system of execution is good, and the workmanship of the highest class. In the iron-foundry four rope-driven travelling cranes, two of 30 tons and two of 10 tons, are provided. The erecting shop is served by 25-ton electric travellers. Amongst the special tools was noticed an electrically driven machine for rectifying the valve seats of the Sulzer engines. The extraordinary finish given to these engines, some of which were seen under course of construction, was commented upon, but the circumstance of the firm's clients being quite willing to meet the extra cost involved soon explained the reason of this seeming unnecessary extravagance. Ghent being noted for its horticultural establishments must account for the visit which was afterwards paid to the nursery gardens of M. Louis Van Houtte. Here the efforts of the engineer had, amongst other matters, been requisitioned in the heating of the numerous conservatories, and the irrigation of the plants by water supplied from an Abyssinian well, the pump drawing it being driven by a 4-H.P. gas engine. After luncheon at the Hotel de la Poste, the cotton spinning works of M. Jules de Hemptinne were visited under his guidance. The engine driving these mills is a fine specimen of the horizontal Nolet type, working at a pressure of about four atmospheres, and developing 1,000 H.P. Attached to the works is a machine shop well fitted with lathes, planing machines and other tools for the making of cards, drawing frames, bobbins, &c. At about 4 p.m. the party left Ghent for Brussels, where the whole of Tuesday was spent as a pardonable off-day for seeing places of popular interest, the inevitable field of Waterloo coming in for attention in the afternoon.

The Brussels Central Electric Light Station, of which M. Wybauw is chief engineer, was open for visiting on Monday and Tuesday evenings, Mr. Phibbs explaining most fully the many points of interest to be observed in this important installation which started work in November, 1893. The India-rubber, Gutta Percha, and Telegraph Works Company were the contractors, the stipulation being that as far as possible all machinery, &c., should be constructed in Belgium, but under their supervision. Current is supplied for lighting purposes at a charge equivalent to 7d. per B.T.U. The system adopted is the three-wire low-pressure distribution, worked in conjunction with accumulators. Business is being rapidly developed, and another smaller station to supply other districts of the city is in hand. The station visited will, when complete, contain plant of 3,000 I.H.P., the unit adopted being a 500-H.P. compound engine driving two 250-H.P. dynamos. At present only two sets of engines have been laid down, made by Carels Brothers. They are of the Sulzer horizontal, side by side, compound condensing type, with adjustable cut-off in the high-pressure cylinder, the low-pressure cut-off being constant. The high-pressure cylinders are 26½ inches diameter, the low-pressure 40 inches, and stroke of each 47¼ inches. The speed can be varied between 62 and 75 revolutions per minute, the higher speed being necessary for charging the accumulators. Each engine is fitted with two 9-grooved fly-wheels, 19¾ feet diameter and 20 tons weight. Each of these fly-wheels drives a dynamo of the four-pole type, with drum armature. These machines were made by the Société Anonyme Electricité et Hydraulique, of Charleroi, and give 143 kilowatts when running at 300 revolutions per minute. In ordinary work they furnish a current of 1,100 ampères at 130 volts, and for charging the accumulators they give 860 ampères at 180 volts, the speed being increased to 360 per minute. The secondary batteries are of the Julien type, made by the Compagnie Electrique, of Brussels. They comprise 140 elements of 325 kilos. of plates, or 715 lbs., including contacts. The total weight of the battery, which will be ultimately doubled, is 78½ tons. The cells are of antimonial lead, placed on small oak squares supported by porcelain insulators. Each cell can give a normal discharge of 350 ampères for 10 hours, and, if necessary, the discharge may for a short time be carried up to 1,400 ampères. The switchboard is placed at a height of 12½ feet above the ground, and is fitted for six pairs of dynamos, a battery of accumulators, and 24 feeders. As to the boilers, these consist at present of three of the Babcock-Willcox type, made by Brouhon, of Liége. The working pressure is 135 lbs. absolute. Each boiler has a heating surface of 2,380 square feet, the maximum evaporation being 7,260 lbs. of water per hour with a good quality of Belgian coal. The grate area is unusually large (56 square feet) so as to permit of coke being used, obtainable from the city gasworks, and which was being employed at the time of the Institution's visit. The feed-water, after passing through a Worthington pump of 2,600 gallons capacity per hour, is conducted through a Dewrance purifier, then through a Green's economiser of 2,160 square feet heating surface, and thence to the boilers. Both the pump and economiser are duplicated for reserve. An electric lift raises the coal to the store situated on the first floor, whence it is conveyed by means of telescopic shoots to the stokehold. The stoking is by hand.

Leaving Brussels on Wednesday morning, the next stopping place was Liége. On the arrival of the train, the Institution was here cordially welcomed by the Association des Ingenieurs sortis de l'Ecole de Liége, in the persons of its president, Prof. Aug. Gillon, and president of the Liége section, Prof. Ad. Firkets. After luncheon at the Hotel de l'Univers, the first works visited in the afternoon were those of the Vieille Montagne (zinc foundry, &c.), at Angleur. In the absence of the managing director, M. Paul de Sinçay, the visitors were shown round by M. A. Gillard, secretary, and by other gentlemen of the staff. The company, founded in 1837, forms one of the biggest concerns in Belgium. At its various establishments in Belgium, France, Germany, Sweden and Italy, over 7,000 workpeople are employed. Last year the total production was 54,839 tonnes of raw zinc, 54,515 tonnes of sheet zinc, and 7,669 tonnes of zinc paint. Included in the specialities of the works is the manufacture of pure zinc for electrical purposes. All the processes were witnessed in operation and explained in detail, including the preparation of the ore (calamine, carbonate of zinc), its reduction at a temperature of about 1,500° C. in the small retorts contained in the furnaces of special design, the casting into ingots, and subsequent rolling, cutting, gauging, and packing into boxes or barrels. One department was occupied in the cutting up and bending of the zinc sections for the formation of the roofs and sides of buildings. The sections are put together by means of an ingenious clip formed in combination on contiguous pieces. Other applications of the material comprised the sheathing of vessels, paper glazing, tacks and wire manufacture, zincography, and for the prevention of boiler incrustation.

After leaving Angleur, the locomotive works of the Société de St. Leonard, near Liége, were seen, the chief engineer, M. Leon Shoest, conducting the party through. Some very good work was on hand, but one could not help remarking the entire absence of hydraulic machinery, the low price of labour, it was understood, being the reason for its non-introduction. Engines have been made for the Belgian State Railways, and lines in other countries. Since 1840 more than 1,000 locomotives have been built, besides engines of other types. The erecting shop, which is served by a 40-ton traveller, is lighted by electricity. Returning to Liége, the members were, in the evening, the guests of the Association of Engineers from Liége University, who provided a magnificent banquet in their honour, taking place at the Hotel de Suède, Profs. Gillon and Fickets presiding. There were only two speeches, one by the first named and the other, in reply, by Mr. Young, Chairman of the Institution.

On Thursday morning the party were whisked off from Liége to Verviers, in acceptance of the invitation of the Verviers Chamber of Commerce. The generous programme provided by them for the whole day was greatly enjoyed. The members were met on their arrival by the President of the Chamber (M. Jules Garot), the secretary (M. Jos. Soubre), M. Charles Mullendorff, M. Paul Peltzer, and others. From

the station carriages conveyed the party to the wool-washing, combing and dyeing works of MM. Peltzer et Fils. Here the preliminary processes in connection with cloth manufacture were seen. Driving through the town from east to west, the next visit paid was to the wool-card manufactory of M. Duesberg-Delrez. The cards are produced by the application of three processes, (1) cutting and preparation of the leather; (2) setting of the points of the cards upon ribbons or strips of leather, or, in other cases, of leather and felt, or of cloth alone; (3) sharpening and finishing the points of the cards with emery polishers. Luncheon was the next incident, served in the pleasant summer hall of the Société de l'Harmonie, M. Garot presiding. There were one or two complimentary speeches on the part of the hosts and their guests, and the party then proceeded to inspect the finishing works in connection with the manufacture of cloth, &c., belonging to MM. Peltzer et Fils. Warping, dressing, weaving, milling and washing, teasing, tentering, shearing, pressing, and steaming, were amongst the operations going on. The time had now arrived for starting for the visit to the famous Gileppe reservoir dam. Leaving Verviers about 3 o'clock the party reached the dam an hour afterwards. The engineer, M. Mahwood explained the general arrangement of the scheme, the working of the valves, &c. The construction of this reservoir was necessitated by the large demand for water in the town of Verviers, not only for domestic purposes but for the washing of wool, &c., in the extensive cloth manufactories of the town. Liége is also supplied from the same source. The thickness of the dam is 216 feet at bottom, and 49 feet at coping; its total height, 154 feet; length at base and at coping, 269 feet and 771 feet respectively; weight, 571,481 tons; section at greatest height, 18,510 square feet. The area of the reservoir enclosed is 197·8 acres, with a contents of 432,224,663 cubic feet. Situated in the valley of the Vesdre, the site is one of great natural beauty, and the charming aspect of the country was much admired. The visitors returned to Liége in the evening, when the central electric lighting station was seen, Mr. Hickson showing the party over.

Friday's arrangements comprised visits to the renowned Société Cockerill's works at Seraing, and to the Val St. Lambert Glass Works. At the former the chairman of the company, M. Delloye Matthieu, and the engineer-in-chief, M. Kraft, received the members. They were shown over the engine works, bridge, girder, and boiler shops, artillery department, blast furnaces, steel works, rolling mills, foundries, collieries, &c. The magnitude of the establishment may be gathered from the fact that the value of the total production of the works is annually about £1,500,000 sterling. As might be expected, the whole place is fitted with appliances specially adapted for dealing with the work they have to execute. There are large hydraulic, electric, and compressed air installations for working forging presses, cranes, &c. At the luncheon, to which the Institution was invited, the chairman of the company presided, and cordial good wishes were reciprocated.

M. Georges Deprez, the manager, received the party at the glass works, and much interest was manifested in the various processes being carried on, including blowing, cutting, engraving, painting, &c. The machines for engraving came in for especial attention. They are exceedingly ingenious. To light the yards, principal workshops and stores, 51 electric arc and 656 incandescent lamps are used.

On Friday evening the summer dinner of the Institution was held in the Salle aux Vitraux of the Hôtel Mohren, Liége. Mr. Young was in the chair, and there was a large attendance. After the Belgian and British loyal toasts had been observed, Mr. P. J. Waldram proposed "L'Association des Ingénieurs sortis de l'Ecole de Liége," which was responded to by their president, Prof. Gillon. To the toast of "Belgian Industries," proposed by Mr. R. W. Newman, Mr. Savage, of the Société Cockerill, replied. "The Institution of Junior Engineers" was proposed by Mr. Douglas, the chairman replying. Other toasts were "The Chairman and Vice-Chairman," by Mr. Fendick; and "The Secretary," to whom a presentation was made in expression of the members' appreciation of his efforts in the successful promotion and working of the meeting.

Saturday was devoted to visits to the small arms works of the Fabrique Nationale d'Armes de Guerre; to the depôt of the Liége Electric Tramways, to the Liége Gas Works, and to the works of the Compagnie Internationale d'Electricité. The small arms works is quite a new affair, and in its design and arrangement some of the latest ideas have been realised. The motive power is electrical, the dynamo being capable of giving a current of 2,400 ampères at a pressure of 125 volts. The energy is distributed by means of copper cables. Nineteen motors are driven, ranging in size from 250 ampères (37 H.P.) to 23 ampères (3 H.P.) All are of the same pattern, and are placed at the point of departure of each line of transmission. The engine driving the dynamo is of the horizontal Corliss compound condensing type, with variable expansion. The working pressure is six atmospheres; revolutions, 65 per minute; maximum horse-power, 530. A 300-H.P. Willans engine has lately been added, running at 350 revolutions per minute, driving direct a dynamo of 1,500 ampères and 125 volts; the foundations are now being put down for another of the same size. At the works of the Compagnie Internationale d'Electricité there was much to see in exemplification of an excellent arrangement and equipment of electrical engineering shops. Here, again, electricity was used as the motive power, many of the larger tools having separate motors to drive them. M. Melotte, the engineer, is to be congratulated on the most conveniently arranged shops under his control, and on the work they produce.

At about four o'clock on Saturday afternoon, August 24th, the members left Liége for the return to England. Everyone appeared to be highly gratified by their reception in Belgium, and were loud in their expressions of appreciation of the kindness met with at the hands of the Belgians.

ELECTRO-DEPOSITION OF BRASS.*

By FRANK SUTTON, E.E.

Introduction.

The process of electro-depositing a single metal has been extensively carried on for a number of years, and is, in fact, a comparatively easy thing to do, if it is carried on with care. But the electro-deposition of an alloy of two or more metals is a more difficult process, and the electrical and chemical principles involved are much more complicated.

The object of this article is perhaps more on a theoretical basis than on a practical one, but really includes both.

The subject chosen was the electro-deposition of alloys, showing:

1st. Under what conditions they would alloy; that is, total necessary voltage, &c.

2nd. The actual voltage that does the work.

3rd. The best solutions to use.

4th. The nature of the deposit.

When the work was started on this subject it was the author's intention to treat not only copper and zinc, but several other salts, but it was found that so many things had to be considered in the limited time, that the salts of Cu and Zn were the only ones that could be treated.

I. The Conditions under which a Solution of Cu and Zn will Alloy.

It is well known that every salt has an initial electromotive force of its own. That is, a force that is set up, to oppose the action of another force, or impressed force, in the case of an electric current being passed through the solution. Now, as will be seen, the solution that has the lowest counter-force set up in it, will be the first one to be overcome by the impressed force, consequently will be deposited first. If this impressed force be raised to a point that is higher than any of the counter-forces set up by the solutions, then they will both be deposited. But, because they are both deposited, it does not necessarily follow that they will alloy; for instance, when the impressed force is raised too high, the velocity of migration of the so-called ions is so great that they will not combine, but will be deposited by themselves. Another point is that the impressed voltage must be kept low, and, in fact, as will be shown, the best results are obtained when this impressed

* *Electric Power*, New York.

voltage is just a little higher than the counter forces of the solution, or, in other words, the current density must be kept small. The operation takes longer, but the results are more satisfactory.

II. The Nature of the Deposit.

As is well known, if the deposit is made too rapidly it will be uneven, and will also fall off and be flaky. One marked thing in the whole set of these experiments was the fact that the deposit was always started at the bottom of the cathode (that is, the plate in this case) and then gradually worked itself up to the top. There are three ways to account for this action, all of which seem to hinge together, namely:

1. The hydrogen bubbles at the top of the cathode, pile themselves up before they escape, thereby hindering the metal from depositing.
2. The solution is denser at the bottom than at the top.
3. If the solution is left alone, that is, not disturbed, the whole action will be rotative.

If the solution be watched when the current is passing, it will look as in the diagram (fig. 1). This back action of

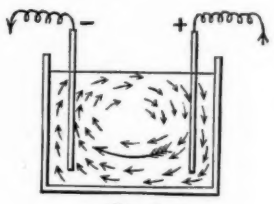


Fig. 1.

the solution is more pronounced at the top than at the bottom, and really does happen, for the reason that the deposit is not only made on the cathode, but also on the anode, and thicker at the top than at the bottom. On low voltages this deposit is very thin and can only be seen after the action has been going on for some time. Of course, this can only be observed on a platinum anode. That, in the case of a brass anode, at first more copper was taken out than zinc, can be accounted for in the following way: every salt has a certain counter E.M.F., as we stated above, which depends upon the heats of combination of the solution; this E.M.F. can be expressed by Thomson's law, which is:

$$e = \frac{H}{23{,}000} \qquad (1)$$

where H = heat of combination. 23,000 = a constant.

The above equation would be very good if the temperature remained constant, but as this is changing, it must be put in the form of

$$e = \frac{H}{23{,}000} \pm T\frac{dE}{dT} \qquad (2)$$

which is Helmholtz's equation, where $\frac{dE}{dT}$ = rate at which the E.M.F. varies.

Now, as was seen, the metal that has the lowest value for e, will be deposited first. The action of the copper being taken out first is more marked as the voltage is increased. If the voltage be raised to a high point there will be nothing left on the surface of the anode but zinc. It is found that, as the E.M.F. is increased, there is an increase of Zn deposit. Hence this seems to open up a conflicting statement, namely, that although the Cu is taken out first, yet there is an increase of Zn at the cathode. One explanation for this is that the Zn, after leaving the anode, has a higher velocity of migration than the Cu, and consequently is deposited faster than the Cu, in the case of a platinum anode. When the E.M.F. is raised to a high point it carries with it a deposit of Zn, which is a great deal thicker at the top than at the bottom.

Another interesting case was when a carbon anode was used. There was nothing deposited on this, for the reason that the carbon disintegrated or was removed, and actually deposited on the cathode, making a dirty deposit; this illustration shows that the action is not only on the surface but also behind it.

In conclusion of this part of the subject the following statements may be made, namely, that the local action, that is, back currents, caused mainly by the counter E.M.F., tends to work towards the surface of the solution and that (as will be seen) this counter E.M.F. is different for alloys that are deposited from the solution, being higher for an alloy that contains more of that metal whose salt solution has the higher E.M.F. This counter E.M.F. not only depends on the solution, but also on the alloy.

III. The Best Solution to Use.

It can be readily seen that the most preferable solution to choose will be one that has the lowest E.M.F.; in case of two salts those whose E.M.F.'s are closest together. Now the difference in the way they are deposited is shown very well from the experiments that were made. Let us proceed to see what was done. The first solution was a mixture of $Cu\,SO_4$ and $Zn\,SO_4$. These two salts have a different heat of combination, and, as it seemed, did not combine well together.

1st Experiment:—

1 part $Cu\,SO_4$ } ½ saturated solution.
1 part $Zn\,SO_4$ }

E.M.F. = 3, current = ·23, temperature 27° C.

The deposit was a fine crystalline deposit, and contained 90 per cent. copper, 10 per cent. zinc.

2nd Experiment:—

1 part $Cu\,SO_4$ } ½ saturated solution.
4 parts $Zn\,SO_4$ }

E.M.F. = 3, current = ·22, temperature 27° C.

Deposit was a dirty brown colour.

TABLE I.

Pure Cyanide solution. Platinum Cathode, Brass Anode. Size of Plates, 10 cm. × 3·5 cm. Distance between plates, 4 cm.

	1 E.M.F.	2 B.E.M.F. Reading.	3 B.E.M.F. $c = \frac{E-e}{R}$	4 Current.	5 $E-e$ Reading.	6 $E-e$ Formulæ.	7 Copper. per cent.	8 Zinc. per cent.	9 Temp.	10 Colour.
1	·1	...	...	...	...	...	0·0	0·0	27°	
2	·15	...	·138	·01	...	·012	100	0	,,	Copper.
3	·25	·18	·188	·051	·07	·062	90	10	,,	,,
4	·29	·20	·206	·07	·09	·084	85	15	,,	Red brass.
5	·50	·30	·308	·16	·20	·192	69	31	,,	Good brass.
6	1·00	·60	·64	·30	·40	·360	67	33	,,	,,
7	2·00	1·41	1·40	·50	·59	·600	62	38	,,	,,
8	3·00	1·86	1·92	·90	1·14	1·08	58	42	,,	Paler.
9	4·00	2·50	2·80	1·00	1·50	1·20	55	45	,,	Very white brass.
10	10·	...	...	...	...	...	...	...	,,	Uneven.
11	18·	...	...	...	...	...	46	54	,,	

3rd Experiment:—

Same as No. 2, only E.M.F. = 2, current = ·1.

Deposit was also a dirty brown. Both analyses show 88 per cent. of Cu, 12 per cent. of Zn.

4th Experiment:—

100 parts $Cu\,SO_4$ } ½ saturated solution.
60 parts $Zn\,Cl_2$ }

E.M.F. = 2, current = ·05.

In this case the two did not combine, but were deposited in patches.

5th Experiment:—

1 part $Cu\overline{A}$ } ½ saturated solution.
1 part $Zn\,Cl_2$ }

Deposit was a dirty brown colour.

6th Experiment:—

1 part $Cu\overline{A}$ } ½ saturated solution.
1 part $Zn\overline{A}$ }

E.M.F. = 4, current = ·1.

In this case the deposit looked more like an alloy, but was very uneven. The two acetates have different heats of combination, but are nearer than the others.

The next experiment tried was a saturated solution of $Cu\,SO_4$ and $Zn\,SO_4$. The experiment was conducted as follows:—Two platinum foils, dimensions 5 cm. × 25 cm. distance between = 7 cm. A glass jar was used of the size of 7 cm. long and 25 cm. wide. From this the resistance of the solution could be calculated. The first thing done was to calculate the specific resistance of the solution. This was done in the following manner:—A glass tube 114 cm. long and 1 cm. in diameter was taken, the ends of the tube were bent up, and into these ends were put two brass terminals. Into this the solution to be tested was introduced, and then a very high voltage was applied, in order to do away with local action. The voltage and current being recorded, and knowing the length and diameter of the tube, the specific resistance was found by introducing the terms in the following formula:—

$$\text{Specific resistance} = \frac{E}{\pi r^2 \times l \times c} \qquad (3)$$

E = E.M.F.
c = current.
r = radius of the tube.
l = length of tube.

In this experiment,

$$\text{Specific resistance} = \frac{115}{\pi\,(\cdot5)^2 \times 114 \times \cdot062} = 20 \text{ ohms.}$$

The next thing we must know is the counter E.M.F. This is found in the following manner. Just before you finish the experiment break the circuit, keeping a close watch on the voltmeter; the moment this occurs the needle will fall back to a certain point, and stop there for an instant, then it will gradually drop down. The point where the needle stops first is the counter E.M.F., as will be shown presently.

(*To be continued.*)

TEST OF PACKARD LAMPS.

A LIFE test of some of these lamps has been made by Prof. B. F. Thompson, of Ohio University, the details of which have been published by a number of our American contemporaries. The lamps seem to be of a high order, the principal feature in their favour being comparative immunity from blackening. As a consequence the candle-power is well maintained throughout a considerable number of hours. No particulars are given as to the manufacturing details of these lamps, but we understand from other sources that the foundation filament employed is the now largely-used "squirted cellulose thread." The slight tendency to blacken, therefore, is probably attributable to the subsequent methods of treating the filaments.

The current to run the lamps—two lots of 25 lamps each, selected at random—was taken from a supply station, arrangements having been made to keep the pressure more than customarily constant. At times, however, the pressure was variable owing to the occasional use of a neighbouring motor. The average E.M.F. during the run was concluded to be about 99 volts. The photometric measurements were made with a Sumner-Brodhun sighting box, and all the conditions of the test seem to have received marked attention and care. We append the two tables of the average readings of the two respective tests, and for various curves of the economic results which have been adduced therefrom, refer our readers to the *Western Electrician* or the *Electrical World*.

TABLE I.—AVERAGE OF LOT NO. 1.

Hours from start of test.	Number lamps burning.	Candle-power.	Per cent. of initial candle-power.	Watts per lamp.	Watts per candle-power.	Candle-power per watt.
0	25	15·54	100	61·00	3·93	·254
96	25	17·58	113·2	63·12	3·59	·279
144	25	17·84	115·0	63·62	3·57	·280
192	25	17·82	115·0	63·54	3·57	·280
252	25	17·53	113·0	63·55	3·63	·275
312	25	17·30	11·14	63·41	3·66	·273
360	24	17·04	110·0	63·30	3·70	·270
408	24	16·08	110·0	63·30	3·70	·270
480	24	16·68	107·5	63·00	3·78	·265
528	24	16·70	107·5	62·73	3·76	·266
600	24	16·35	105·3	62·64	3·83	·261
648	23	16·07	103·4	62·60	3·90	·256
696	22	15·83	102·0	62·60	3·95	·253
768	22	14·81	95·3	61·94	4·17	·240
812	22	14·50	93·3	61·51	4·24	·236

TABLE II.—AVERAGE OF LOT NO. 2.

Hours from start of test.	Number lamps burning.	Candle-power.	Per cent. of initial candle-power.	Watts per lamp.	Watts per candle-power.	Candle-power per watt.
0	25	14·77	100	49·60	3·36	·298
96	25	15·06	102	50·00	3·32	·301
144	25	15·13	102·5	50·23	3·32	·301
192	25	15·01	101·8	49·96	3·30	·303
252	25	14·93	101·2	50·10	3·35	·299
312	24	14·85	100·5	49·78	3·35	·299
360	24	14·82	100·3	49·76	3·36	·298
408	24	14·67	99·3	49·70	3·39	·295
480	24	14·65	99·3	49·52	3·39	·295
528	24	14·70	99·3	49·31	3·36	·298
600	24	14·50	98·2	49·33	3·40	·294
648	24	14·16	96·0	49·00	3·46	·289
696	24	13·87	94·0	48·92	3·53	·283
768	24	13·29	90·0	48·50	3·65	·274
812	24	12·97	88·0	48·25	3·72	·269

ELECTRICAL PLANT IN THE TRANSVAAL.

THOSE electrical engineers who three years ago recognised the future value of the Transvaal market, have reason to congratulate themselves upon their foresight. In the interval since then, says the *British and South African Export Gazette*, the consulting engineers of the Witwatersrand, De Kaap, and Lydenburg Fields have shown the utmost readiness to avail themselves of the opportunites afforded for increased economy and efficiency by the employment of electrical energy for transmission purposes. Three years ago South Africa was far behind the United States in the application of electricity to mining; to-day it easily leads the world in the extent of its electrical equipment. On the Rand the old method of working by means of several shafts scattered all over a property has been practically superseded by the system in which, by the aid of central electrical stations, power for all the operations of the mine is obtained from one or two main shafts. In the Barberton district a large advance in economy has been achieved by the utilisation of natural water powers to supply electrical energy to little groups of mines. The Lydenburg Fields have earned some distinction in the same direction by possessing a stamp battery worked by electricity from a waterfall some miles distant. And these past achievements are but a humble indication of the vast extension of electrical engineering which is promised by the present activity in the Transvaal. It will not be long before the surface buildings at all the mines along the 50 miles of the Witwatersrand reef will be illuminated by electricity, and its use in this way will of course be accompanied by its employment for power transmission. The new central station at Brakpan, which is to supply current along the main reef up to Paardekraal, is now in process of construction, and the larger part of its effective capacity of 2,000 H.P. is already contracted for. This important undertaking is one of the several instances which have been provided on the Rand of late of big machinery orders going to German firms. Messrs. Siemens & Halske, of Berlin, have contracted to lay down the installation at a cost of £210,000, and they have placed the order for the steam generating plant with the Sachsische Maschinenfabrick, of Chemnitz. Even this extensive provision will be but a small contribution towards supplying the Rand's demand for electrical power. The process of amalgamation and the institution of deep-level mining have so far enlarged the scale upon which properties are worked, that single mines require central electric stations of absolutely gigantic proportions. Moreover, now that electricity has become a familiar agent in mining work, the extent of its applications has been greatly widened. Formerly its use in power transmission was practically confined to the unwatering of the mines. Now, in addition to the pumping plant, machine tools, fans, and haulage mechanism are

driven by motors. A large field has opened up for their use in connection with the modern development of the cyanide process. In the most up-to-date cyanide plants, the cyanide wheel, the pumps, the hauling gear, and the lathe by which the zinc shavings are now cut, are all driven by electricity, while the action of the chemical itself is supplemented by electro-deposition. The overhead wire system of electric tramway has also been introduced on the Rand, and there may in time arise a large demand for electrical locomotives for underground work. But undoubtedly wire ropeways, worked by electricity, are coming more and more into favour in the Transvaal. As to pumping, it is pretty certain that the unwatering plant of the deep levels will be generally worked from a central electrical station, in place of the old plan of putting down a Cornish pump at the start of each shaft. The water to be dealt with is as yet an uncertain quantity, and there are obvious advantages in being able to increase the plant precisely as may be found necessary. As showing the wide variety of uses to which electricity is now put on the Rand mining field, it may be mentioned that in the new plant at the Modderfontein mine, the four 54-unit dynamos will drive no less than nine motors. These will provide power for the workshop machinery and cyanide pumps, the ore-hauling hoist, the electric tram, and the tailings haulage.

It is certainly a striking testimony to the enterprise and skill of British engineers that practically the whole of the orders involved in this wonderful development of electrical plant have been executed in British workshops. The Americans—strange enough, considering how much they have done in their own country to find out the possibilities of electrical power transmission—have secured little or no share of this trade. Messrs. Siemens & Halske, Messrs. Schuckert, and one or two other German firms have secured almost the only business which has not come to England. And it must certainly be admitted that British firms have deserved this pre-eminence by the energy and judgment they have shown in adapting electrical plant to South African mining purposes. The Brush Electrical Engineering Company, Limited, was one of the firms to receive orders from the Transvaal mines, but as our "Order Columns" will show, other makes of dynamos and motors have now secured a wide range in the market. The "Goolden" dynamos of Messrs. Easton, Anderson and Goolden, Limited, have been widely employed, their success in the coal mining districts at home being a high recommendation for their employment in mining work. The Electric Construction Company, of Wolverhampton, have also done a large business, and their machines seem to be still growing in favour, thanks largely to the wide experience and high reputation of Mr. J. Hubert Davies, M.I.C.E., who has adopted them in many of the large contracts he has carried out. In the same manner the "Edison-Hopkinson" dynamos of Messrs. Mather & Platt, Limited, Manchester, owe their extensive employment in no small measure to the hold which their representatives in Johanneaburg, Messrs. Reunert & Lenz, have acquired upon the electric engineering industry on the fields. At the present time we believe that generators and motors of this type are being put down at seven of the Rand mines. Messrs. Johnson and Phillips, Limited, are another firm whose electrical machinery is well known in the Transvaal. Messrs. Ernest Scott & Mountain, Limited, have also lately come into the market, but have not yet secured a great hold upon it.

THE UNITED STATES OF AMERICA AND THE PACIFIC CABLE.

The following telegram from the Hawaiian Islands, which is published in a Californian contemporary, shows that the Americans have advanced an important stage in this matter. Bearing in mind the serious attention which the vote for a subsidy to this cable received in the last session of the U.S. Congress, it seems not improbable that in the course of the next few months we may learn that this project has taken final and definite shape:—

"Honolulu, August 14th.—Hawaii will have a cable 'to the west coast of North America,' and an inter-island system as well, if the United States co-operates. This Government has made a contract with Colonel Spaulding, giving him a subsidy of $40,000 annually, and an exclusive grant for 20 years. He has deposited $25,000 of Hawaiian bonds as a forfeit. Work is to begin in 15 months, and to be completed in three years, conditioned always that the United States lends the project 'substantial assistance.' Colonel Spaulding leaves for the coast to-day, and will be in Washington when Congress convenes in December. Colonel Spaulding is an active and wealthy man of affairs himself, with extensive interests in Hawaii, and, besides, has English and American financial connections. He hopes to get a subsidy of $250,000 a year from the United States. The cable contract was laid before the Chamber of Commerce here, and was opposed by three of the largest business firms on the islands. They objected to the exclusive franchise, and to the undue haste of the transaction. The whole business was done in four days. Indorsement was given by the Chamber by a large majority. There was one vote in the negative in the Senate, and another in the House. The termini of the cable are Honolulu and San Francisco. The subsidy is to be paid $10,000 quarterly. It is proposed to raise the money by placing a duty of $6 a pound on opium. This was suggested by Senator Brown on the floor of the Senate, but was not debated. Opium is now contraband, but the country is flooded with it, and the expense of the customs force watching for it is enormous. It is hinted, too, that the peace assured by having a cable would permit reduction of the military force. The contract signed by this Government grants exclusive franchise for twenty years, but provides that the grant shall not prevent any foreign government having existing treaty rights with the Republic of Hawaii allowing any such government so to do, to land a cable upon the Hawaiian Group for other than commercial purposes, from any point on the North American continent. The Government agrees to pay the contractor an annual subsidy of $40,000 for twenty years from the date of the establishment of telegraphic communication between Honolulu and a point at or near San Francisco and the islands of Hawaii, Molokai, Maui and Kauai. The subsidy to be paid in quarterly instalments of $10,000 each. Work on the cable must begin on or before the May 1st, 1897, and the line must be completed by November 1st, 1898, otherwise the contract is void. If Spaulding fails to obtain assistance from the United States, the Hawaiian Government may cancel the contract. The company will be exempt from duty on material, taxes, port charges, in addition to other privileges. The maximum rates for messages, other than Government messages, over the cable between Honolulu and San Francisco, shall be such as shall be agreed upon in any contract which shall be made between the contractor and the United States Government, not exceeding $1 per word, and any contract with such Government shall prescribe a maximum scale of rates. If telegraphic communication shall be hereafter established between the Hawaiian Islands and Australia or Japan, the rate to be charged for any message transmitted from Honolulu to San Francisco, or from San Francisco to Honolulu, shall not exceed a *pro rata* proportion, based on distance, of the regular rate for transmitting a similar message to or from San Francisco and Australia or Japan. Press messages shall not exceed one-half the regular rates which shall be charged for other messages, excepting Government messages. It shall not be obligatory upon the contractor to send any press message for less than $1. During twenty years all messages concerning the official business of the Hawaiian Government shall be transmitted free up to the amount of the annual subsidy paid by the Government to the contractor. The specifications cover seven pages of typewritten legal 'cap, giving a technical description of materials, method of construction and laying. The California cable will contain 400 lbs. of copper and 300 lbs. of gutta-percha per mile, and will be 2,500 miles long. The inter-island will have 100 lbs. each of copper and gutta-percha, and will be 177 miles long. The cable will be landed at Monterey on the American end, and on Waikiki beach at this end. The survey made several years ago by the *Albatross*, under Captain Tanner, is the one to be used by Spaulding. The Government has been quite severely criticised for its covered action on the cable contract. It made nothing public until the agreement had been signed."

NEW PATENTS—1895.

16,008. "An improved telephonic instrument designed for use on poorly insulated lines, such as the existing wires of an ordinary wire fence." G. Dillberg and P. Rabbidge. Dated August 26th. (*Complete.*)

16,019. "Improvements in connection with incandescent electric lamps and their holders and fittings." J. Y. Johnson. (Communicated by A. Swan, United States.) Dated August 26th.

16,022. "An improved form of cell for primary or secondary electric batteries." E. Burnet and F. F. Smith. Dated August 27th.

16,042. "A compound electrical testing switch." H. D. Norman. Dated August 27th.

16,068. "Improvements in connection with the propulsion of road or other vehicles." M. H. Smith. Dated August 27th.

16,077. "Improvements in electro-magnetic tools." W. P. Thompson. (Communicated by A. G. Fonda, United States.) Dated August 27th. (*Complete.*)

16,173. "A switch formed as a handle in which electric circuit is completed by the automatic fall of a piece of solid metal contained within the handle." C. S. Newman. Dated August 28th.

16,218. "Improvements in electrical fire and burglar alarms." J. R. Shearer. Dated August 29th.

16,247. "Improvements in or connected with electric cables or conductors." H. Edmumds. Dated August 29th.

16,248. "Improvements in electric transformers and dynamo armatures." H. Edmunds. Dated August 29th.

16,275. "Improvements in instruments for making electrical and magnetic measurements." J. Finlayson. Dated August 30th.

16,287. "Improvements in dynamo-electric machines and motors." L. Halle. Dated August 30th. (*Complete.*)

16,350. "Improvements in or relating to electric batteries." A. J. Boult. (Communicated by E. A. Wunderlich, Germany.) Dated August 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1894.

11,211. "Improvements in railway electrical signalling apparatus." W. Grimes. Dated June 9th. Relates to improvements in signalling apparatus, described in No. 6,677, dated March 30th, 1893. 10 claims.

11,320. "Improvements relating to telegraphic transmission." H. H. Lake. (A communication from abroad by M. I. Pupin, of New York.) Dated June 11th. The object of the invention is to enable a large number of messages to be sent simultaneously over a single conductor by means of currents of the same or of different periodicities. 2 claims.

13,636. "Improvements in perforators used for transmitting telegraphic messages and cablegrams." H. Whawell. Dated July 14th. Consists in doing away with the spur wheel and working the feed by means of a ratchet wheel and friction roller, both working on the same axle; the paper passes and is held down in its place by another small roller immediately over it, and above this roller is a small spring bearing on it (the top roller). 4 claims.

14,340. "An improved electro-massage roller appliance." H. C. R. Sharman. Dated July 26th. Consists of the ordinary or any other special type of massage-rubber, but is so arranged as to contain in the handle, reel, or other part of the appliance an electric battery. 4 claims.

15,353. "Improvements relating to electric motors." W. Routledge. Dated August 11th. Relates to electric motors, and has for its object to adapt them for driving dental engines. 5 claims.

15,985. "Improvements in or connected with electric arc lamps." W. H. Akester and H. H. Price. Dated August 22nd. The runners carrying the respective carbons are suspended by chains as heretofore, but these chains, according to the present invention, are carried partly around a grooved pulley or flanged wheel in opposite directions, the end being fixed thereto. 1 claim.

16,131. "Improvements in electric signs and advertisements." W. D. Hawksey and I. M. Lamb. Dated August 24th. According to this invention the letters, characters, or devices constituting the sign or advertisement are formed of glass tubes, bent when necessary to the required form, and having therein an axial filament of carbon connected with platinum electrodes or supports which are fused in the walls of the tubes, each of which is exhausted of air and hermetically sealed in the usual manner. 3 claims.

16,331. "Improvements in electric organs." P. R. Harrison. Dated August 27th. Consists in means for adapting to electric organs, the invention described in Specification No. 11,152, 1894, the object of which is to obtain, by the depression of one key from a single set of organ pipes, two or more sounds in intervals of octaves. 3 claims.

16,473. "An improved system or method of arranging telephones and appliances in connection with the same, by which the currents required either for calling for, or notifying the completion of communications to, the different subscribers, are sent automatically." G. Ritter. Dated August 29th. The improved arrangement of the telephone system which forms the subject of the present invention is such that by taking down the telephone for use and by hanging it up again, when the conversation is concluded, the connections act automatically at the place of exchange, the currents which effect this action not being provided at the different subscribers' places but at the exchange station. 6 claims.

16,542. "Improvements in or connected with search-light projectors." J. B. Furneaux and H. Walker. Dated August 30th. The object of this invention is to enable the director in the conning tower or other suitably protected part of a battleship to control a search-light projector situate at some other part of the ship, without the assistance of another person at the projector itself, thus obviating, in time of action, the exposure of a man at a dangerous position. 2 claims.

16,599. "Regulating electric currents." L. B. Miller. Dated August 31st. Consists of a choking coil or transformer wound with wire in one long spiral, in order that there should be as little difference of potential as possible between neighbouring convolutions. 2 claims.

16,857. "Improvements in telegraphy, and in the means employed for perforating tapes used for this purpose." P. B. Delany. Dated September 4th. The object of the invention is to provide an improved system of perforation, mechanical transmission, locally or from a distance, and improved recording devices for reception of signals over ocean cables or difficult landlines, with a view of increasing the speed of working, and rendering the signals plainer. 14 claims.

16,918. "Improvements in access and junction boxes for electric conductors." A. Fox. Dated September 5th. The object of the invention is to construct the access and junction boxes used for telegraph or telephone cables or conductors in such a manner that they may be readily fixed where required, especially where branch junctions are to be made with the main conductor, and shall be perfectly water-ight throughout against leakage into them, especially where the pipes enclosing the cables or conductors enter the boxes. 1 claim.

16,943. "A new or improved portable ladder platform for the use of telephone or telegraph linesmen, or the like." T. Langlois, jun. Dated September 5th. Consists of a light framework of wrought-iron, or other suitable material, of such a shape and form that it can be readily attached or hooked on to the rungs of the ladder, while the upper part of this framework has a platform of sufficient size hinged to same, and which in the normal position hangs flat against the said framework, but which when it is required for use can be raised until at an angle of 45° with the framework, when it is secured in position by two ropes, one at each side of same, which are passed around one of the cross bars, or the like, of the pole carrying the wires, &c., under repair. 2 claims.

17,077. "Improvements in lenses and electric lamps, more especially intended for use for theatrical stage purposes." W. P. Dando and J. E. A. Gwynne. Dated September 7th. The object of this invention is to provide lenses and electric lamps more especially intended for use for theatrical purposes, the lamps being arranged so that they can be readily manipulated and regulated by hand, and lenses being provided which give a better lighting effect than is obtainable with the ordinary lenses. 5 claims.

17,357. "Improvements in arc electric lamps." S. S. Allin and W. H. Wood. Dated September 12th. The objects of the invention are to produce an improved method of striking the arc without moving or interfering with the feed mechanism, and of feeding together the carbons very gradually, as they consume without breaking the controlling circuit. To produce a lamp adjustable for working on either continuous or alternating circuits, and with currents of largely varying volume, and capable of working on very small currents. 5 claims.

17,369. "An improvement in secondary voltaic batteries." L. Epstein. Dated September 12th. The negative plates consist of discs of copper wire gauze, amalgamated and coated with zinc electrolytically deposited on the amalgamated surface. These discs are fixed on a spindle which extends along the cell, passing through the positive plates without touching them, or insulated from them. From time to time this spindle is turned partly round so as to avoid unequal action on the discs, owing to the difference of density of the electrolyte at different depths. 3 claims.

17,542. "Improvement in the construction of the lead lining or casing of cells or boxes of electric storage batteries." J. E. Liardet. Dated September 14th. Consists in casting the lead lining in one piece, by which a perfectly watertight vessel is obtained. 2 claims.

17,566. "Improvements in electrodes, chiefly designed for use in electric accumulators." W. Schafer and A. Heinemann. Dated September 15th. Consists in the employment in the manufacture of the plates, which are to be converted into electrodes, of a compound known as glycerate of lead. 5 claims.

17,808. "Improvements in electric arc lamps." H. Lyon. Dated September 19th. This invention has for its object to construct electric arc lamps with improved automatic apparatus for adjusting the relative positions of the carbons in a manner to maintain a practically steady light. 2 claims.

18,999. "Improvements in electric fuses for mines and like purposes." W. P. Thompson. (A communication by La Société M. Gaupillat & Co., of Paris.) Dated October 6th. Relates to an improved kind of fuse for mines and for like purposes, the firing of which is effected by the passage of an electric current between imperfect contacts arranged in the interior of the fuse, the resistance of which causes a sufficient elevation of temperature to ignite the powder contained in the said fuse. 1 claim.

25,215. "Improvement in electrically propelled vehicles." H. C. Baker, H. Stone and J. R. Elberg. Dated December 28th. The object of the invention is to produce, in combination with a light vehicle of any character or type, and an electric motor carried thereby, a mechanism which, deriving its motion from the motor, propels the vehicle at any suitable speed, and with the least possible noise. A further object of the invention is to produce a vehicle of this character which is simple, strong, and inexpensive of construction, and which may be thrown in or out of gear with the motor at will. 3 claims.

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3,095. "Improvements in and relating to electrical exchange systems." G. W. Hey and A. E. Parsons. Dated February 12th. Relates to improvements in electrical exchange systems for permitting communication between different metallic circuits. 8 claims.

5,568. "Improvements in or connected with alternating current arc lamps." W. P. Thompson. (A communication by W. Mathiesen, of Leutzsch-Leipzig.) Dated March 16th. Claims:—1. In alternating current arc lamps the arrangement of a half globe of semi-translucent or light-absorbing glass, either open at the top or covered by clear glass, in combination with an outside reflector placed above the same, or for use in indoor installations with a white cover for the purpose of utilising the rays of light radiated upwards without forcing them to pass through semi-translucent glass, substantially as described. 2. In alternating current arc lamps, the arrangement within a clear glass globe of a small semi-globe of semi-translucent glass open at the top, together with an outside reflector placed above the clear glass globe, substantially as and for the purpose set forth.

5,693. "Improvements in and relating to electrical railways and tramways." F. P. Bergh and C. W. Tarbox. Dated March 19th. Relates to electric railways of the class in which current is supplied to the motor on the vehicle from a conductor of electricity located in a conduit extending along the roadway under the car, and consists in the use of a series of exposed points which are connected with a continuous insulated conductor by the car as it travels along, and contact is maintained with at least one of these points all the time by means of a longitudinal shoe or skid carried by the car. 4 claims.

5,699. "Improvements in electric arc lamps." G. R. MacIntire. Dated March 19th. The chief object in the invention is the production of an arc lamp which shall be exceedingly compact, and therefore available for use more generally than the arc lamps heretofore constructed. A further object is to so arrange the feeding mechanism that it shall act positively, and at the same time shall permit the carbons to be advanced by gravity or by spring pressure. 5 claims.